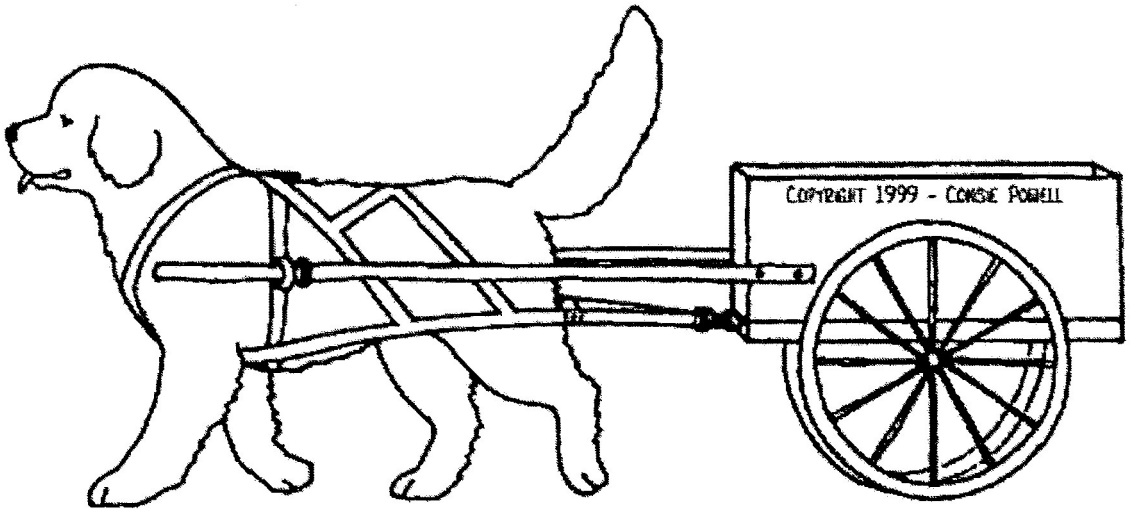
Newfoundland Club of America

Draft Equipment Guide

produced by the NCA Working Dog Committee



Introduction

Draftwork involves teamwork between a dog and its handler. In this partnership the handler is responsible for choosing appropriate equipment for the dog to use to haul a load. A handler should not expect the dog to pull with an inappropriate harness or an apparatus that causes the dog to work harder than necessary to get the job done.

In a draft test, the regulations allow for an apparatus to be failed if it is not appropriate for the course. Before choosing to enter a test, it is the handler's responsibility to read the course description detailed in the premium list. The decision to enter should then be based on matching the course to be used and the equipment that is available to the handler. The Introduction to the Draft Test Regulations states that since a dog can perform draft work only in cooperation with a person, each handler must demonstrate his or her understanding of draft work as it pertains to the dog's ability, training and equipment. It further states under 'Equipment' that the handler provides the draft equipment including harness, traces, and draft apparatus appropriate for the test site conditions. That information is important and allows a judge to fail equipment if he or she does not feel it is appropriate to the site and other conditions on the day of the test.

The following brief guidelines should help handlers in making the correct choices of equipment both for tests and for general draftwork. However, these are just guidelines. The WDC encourages handlers to attend seminars, contact experienced handlers or experiment with equipment in safe and controlled situations in order to continue learning more about draft equipment.

Table of Contents

Draft Apparatus

- Wagons
- Carts
- Travois
- Sleds
- Toboggans
- Pulks

Understanding Equipment

Balance

Wheels
Hitching
Shafts
Brakes

Harnesses
- Siwash
- Cross-Chest or Parade

Equipment Illustrations

Siwash Harness with Spreader Bar and Single Attachment
Siwash Harness with Two Traces and Double Attachment
Parade Harness

Equipment Checklist

Equipment Guide artwork provided by Consie Powell (c) 2001

Apparatus for non-snow conditions (Wagons, Carts, Travois)

Wagons

A wagon is a four-wheeled apparatus. It is usually spacious and can accommodate a larger load than a cart. Because it has 4 wheels, it does not tip, so balance of the load is not critical in a wagon. But what you gain in stability, you lose in maneuverability. A wagon is more difficult than a cart to back and a large wagon may need an auxiliary brake for going down hill when loaded. Wagons work best on level ground with fairly even surfaces. They are ideal on asphalt and on other road surfaces. The shafts for a wagon bear no weight from the load, so the position of the shafts is not as critical in a wagon as it is in a cart.

Carts

A cart is a two-wheeled apparatus. It is a very versatile piece of equipment as it is highly maneuverable and is easily backed. But what you gain in maneuverability, you lose in stability; so balancing a load correctly is critical in a cart. Modification to the center of gravity, point of balance and type of wheels allow a cart to be adapted for use by different dogs and in different situations.

Travois

A travois is essentially two long shafts, attached to the sides of a dog, which drag on the ground. A load is strapped to the shafts behind the dog.

Understanding the historical use of a travois provides draft work enthusiasts with some insight into the appropriate use for a travois. According to N. Henderson, 'Replicating the Dog Travois Travel,' Native American travois were suited to travel through open landscapes and seem to be limited to the Plains. Henderson makes a reference to the travois gliding over the tall prairie grasses. Through thick brush or woodlands, dogs were outfitted with backpacks.

Because a travois drags directly on the ground, there is always significant friction between it and the ground. The dog must work constantly and pull harder than with a wheeled apparatus. Due to the constant drag, 5 pounds of weight hauled with a travois is essentially equal to 25 pounds pulled by a wheeled apparatus. However, with a travois, there is no relief or let up on the dog.

A travois is not suitable for general draft work because it is so inefficient. It could be used in open pastures and on uneven plains, or in areas where wheels might get mired down. Wherever a wheeled apparatus can be used, it is always preferable. Carts and wagons are more comfortable and efficient and less demanding on the dog. A travois is not suitable for use on asphalt or other solid surfaces well suited to wheels.

Apparatus for Use on Snow (Pulks, Sleds, Toboggans)

The varieties of apparatus that can be used on snow all have the common trait of sliding directly on the surface, either on runners or on the bottom. Some may use shafts; others are pulled by a trace attached directly to the apparatus. Balance of a load on snow apparatus is not crucial since the weight of the load is down very low or directly on the ground. A load should be carefully secured, however, because placement of the load may affect pivot point and maneverability. Sleds, toboggans and pulks can usually carry a good-sized load, but due to the friction with the ground, a dog must work harder to start the load. For this reason, the weight required for a draft test is less, than that required for carts and wagons. They also generally require more space to turn than wheeled apparatus. Because traces for snow apparatus are often long, a handler must be particularly aware that the dog does not start hauling with the traces tangled with a foot, or with traces positioned improperly.

Sleds

A sled is an apparatus that has runners to elevate the bed of the apparatus, and works best on ice or hard packed snow; it does not work well in deep or fluffy snow. They include classic dogsleds and conventional children's sleds. A trace connects the dog I s harness to the bed of the sled. Because a sled does not have shafts, the dog cannot stop. the sled's forward motion. Stopping a sled must be accomplished by a foot or hand brake operated by the handler (as on a dogsled) or by a line attached to the back which can be held by the handler. Uphill or rough snow conditions may work to set-brake a sled, but a handler must always be aware and responsible for stopping the sled before it hits the dog, Traces are usually longer for sleds than for' carts or wagons in order to allow space for the sled to be stopped before hitting the dog. A dog cannot make a sled move backward; backward motion must be accomplished by the handler with the cooperation of the dog backing to slacken its trace.

Toboggans

A toboggan is an apparatus that has a curved front and a flat bed that rides directly on the snow. It works well on ice or hardpacked snow, and can also work reasonably well in deep or fluffy snow. Like a sled, it does not have shafts, so attachment of traces to the dog is the same as for a sled. A toboggan does not have a hand or foot brake like some sleds, so braking must be done through the use of a line attached to the back and held by a handler. When using a toboggan in deep or fluffy snow, the snow frequently brakes the apparatus. Toboggans are excellent for hauling significant loads in snow.

Pulks

A pulk is an apparatus with a flat bottom that rides directly on the snow, but with curved edges that give it the shape of a very shallow 'boat'. Some pulks have shallow runners on the bottom. Because of its shape and the shallow runners, a pulk works very well in most kinds of snow. Pulks usually have shafts, but can also be used very efficiently with the shafts removed. Using a pulk with the shafts attached gives the advantage of heightened stability and prevention of sidestepping on slopes and the ability of the dog to brake the pulk, but adds the disadvantage of needing a large turning radius. Using a pulk with the shafts removed gives the advantage of greater maneuverability but does not allow for the dog to brake the pulk. Without shafts, a pulk is attached to a trace and is braked like a toboggan.

When a pulk does have shafts, the position of the shafts is not as critical as on a cart, since there is no weight from the load on the shafts. Shafts can rise from the pulk at a gradual angle to the side of the dog, or they can rise at an angle, then bend to run parallel to the ground along the side of the dog. The traces or singletree of the harness can attach at ground level to the front of the pulk or to a raised section between the shafts, if using shafts with a bend.

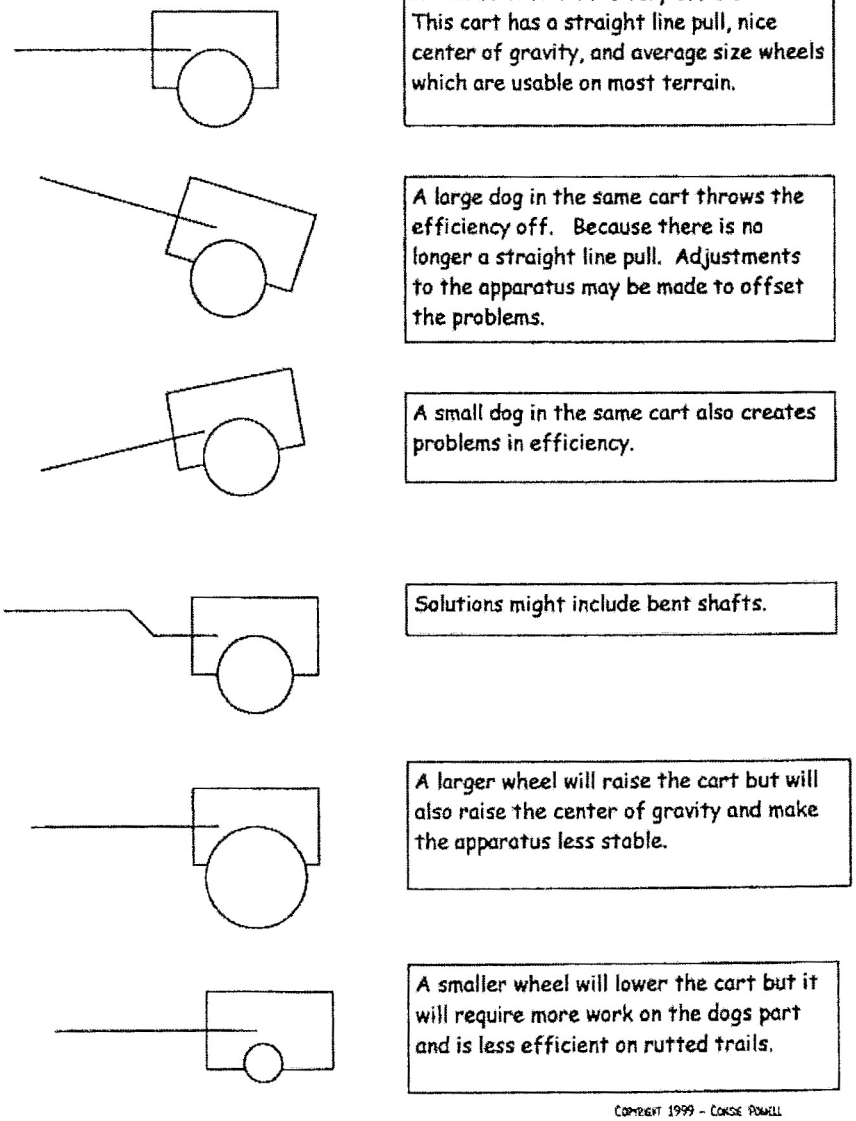
Understanding the Equipment

Balance

Understanding freight loads and how to balance them is an essential part of draft work. In wagons, balance of the load is not critical because wagons are inherently stable. Balance of a load is critical with a cart. The point of balance in a cart is not always over the axle, but rather over the center of gravity. This point can vary depending on the weight of the shafts. It is a handler's responsibility to check the apparatus when loaded to make sure that the freight is placed correctly to maintain the balance of the cart and the comfort of the dog. The shafts should not feel any heavier or lighter after loading. If the load is too far back it, the shafts will be light and bounce around pulling the harness up. If the load is too far forward, the shafts will be heavy and place unnecessary stress on the dog. An unbalanced load will decrease the efficiency of the pull as well as the comfort of the dog.

Sulky carts were designed to hold people, and when properly balanced, weight needs to be placed where a passenger would sit, not on the floor of the apparatus.

figure 1. Cart Modifications


A well balance cart is very efficient. This cart has a straight line pull, nice center of gravity, and average size wheels which are usable on most terrain.
A large dog in the same cart throws the efficiency off. Because there is no longer a straight line pull. Adjustments to the apparatus may be made to offset the problems.
A small dog in the same cart also creates problems in efficiency.
Solutions might include bent shafts.
A larger wheel will raise the cart but will also raise the center of gravity and make the apparatus less stable.
A smaller wheel will lower the cart but it will require more work on the dogs part and is less efficient on rutted trails.
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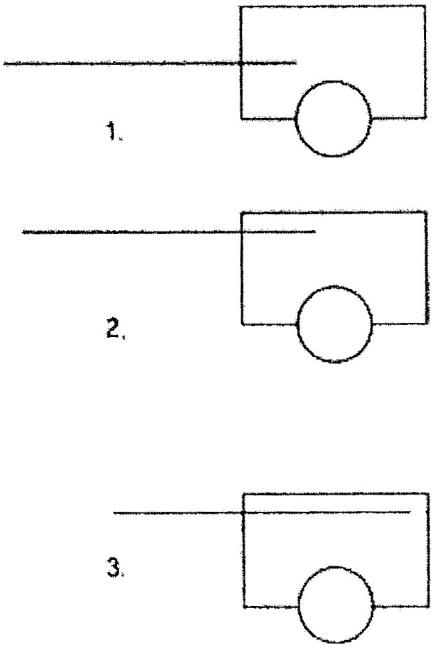


This cart can be modified in many ways.

In figure #2, the shafts are raised to accommodate a larger dog.

In figure #3, the shafts are simply moved in and therefore the cart can accommodate a shorter bodied dog. The shafts will not interfere with turning radius.

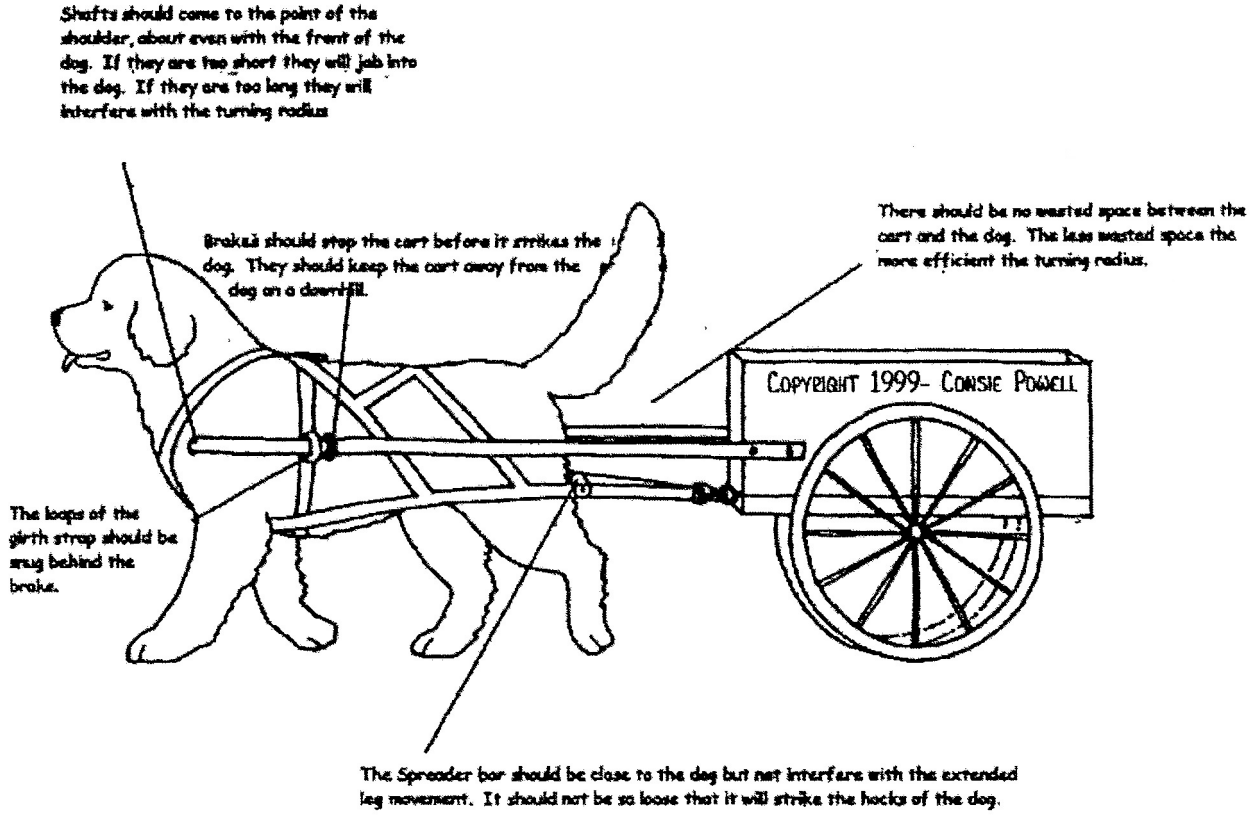
When modifications are made to an apparatus, the point of pull should remain unrestricted. The shafts should remain approximately parallel to the ground for the most efficiency.

Wheels

The size other wheels on a wagon or cart is important. Small wheels are inefficient, and the dog must work harder to pull a loaded apparatus. Small wheels are not recommenced on hills and uneven terrain. Larger wheels ease the workload, but since they, make the center of gravity higher, the apparatus could tip more easily. The type of wheels should also be taken into consideration. Wide wheels are better on soft sand and in areas where a thin wheel would sink. Air-filled tires or tubed-tires provide a cushioned ride but a handler must have the necessary equipment along in order to repair a flat tire if one should occur while working or during a test.

Hitching

A harness is attached to a wheeled apparatus at a single point if you are using a spreader bar or singletree and at two points if you have separate traces. The most efficient pull occurs when the traces are parallel to the ground. The point where a harness (or traces) attaches to the apparatus may be raised or lowered to accommodate a larger or smaller dog and still pull efficiently.


Shafts should come to the point of the shoulder, about even with the front of the dog. If they are too short they will jab into the dog. If they are too long they will interfere with the turning radius
Brakes should stop the cart before it strikes the dog. They should keep the cart away from the dog on a downhill.
There should be no wasted space between the cart and the dog. The less wasted space the more efficient the turning radius.
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The loops of the girth strap should be snug behind the brake.
The Spreader bar should be close to the dog but not interfere with the extended leg movement. It should not be so loose that it will strike the hocks of the dog.

Shafts

Shafts are used to guide the apparatus and are part of the braking system. On a cart they extend directly from the cart to the sides of the dog's body. On a wagon they are attached to the wagon's steering mechanism and extend from there to the sides of the dog's body. On carts the shafts should be parallel to the ground. The parallel position is not as critical in a wagon because the weight of the load is not extended onto the shafts in a wagon. The point where the harness (or traces) pulls on any apparatus should not be from the shafts but from the body of the apparatus. (The lone exception to this is with a travois, where the shafts are the apparatus.) Shafts should come to a point of the dog's shoulder that is about even with the front of the dog. If the front of the shaft is too long, it will interfere with the turning ability of the dog; too short and the shafts will jab into the dog on turns. The overall length of the shaft should allow the dog to be able to fully extend its hind legs without striking the cart. Shaft length should be checked while the cart or wagon is moving and when it is loaded.

Brakes

The shafts also provide a place for brakes. Brakes consist of a projection either on top of, underneath, or around the shaft. The projection should be right behind the loop on the girth strap of the siwash harness. The loops of the girth strap should never be behind the brake. There should be no space between the loop and the brake. Brakes keep the cart or wagon from hitting the rear of the dog.

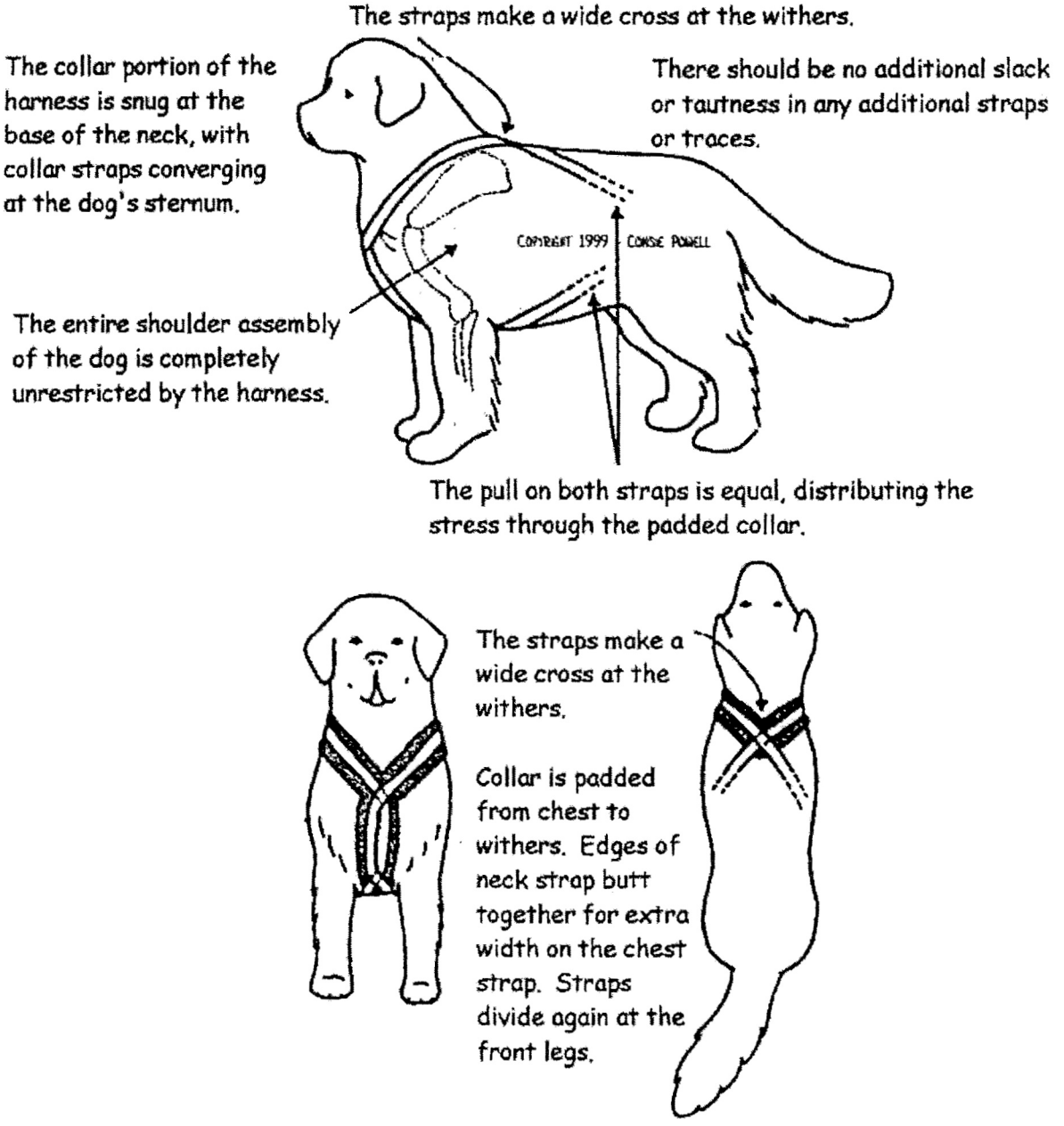
Conventional racing dogsleds have a foot brake that a handler can use to slow the sled. When using a shaftless pulk, sled or toboggan, snow will often serve to brake the apparatus, but a trace or lead attached to the rear can be used by a handler to keep the apparatus from bumping the back of the dog on downhill grades.

Harnesses

Siwash Harnesses

The WDC recommends the use of a siwash harness. There are many variations on the siwash, but they all work essentially the same. With a siwash harness, the dog pushes with its neck and chest into the collar and chest-piece of the harness, and its legs remain unrestricted. It is well suited for all types of terrain. Because of the way it fits the dog, a siwash is more comfortable and more efficient in use than other harness types.

Figure 4. Properly fitted Siwash Harness


The straps make a wide cross at the withers.
The collar portion of the harness is snug at the base of the neck, with collar straps converging at the dog's sternum.
There should be no additional slack or tautness in any additional straps or traces.
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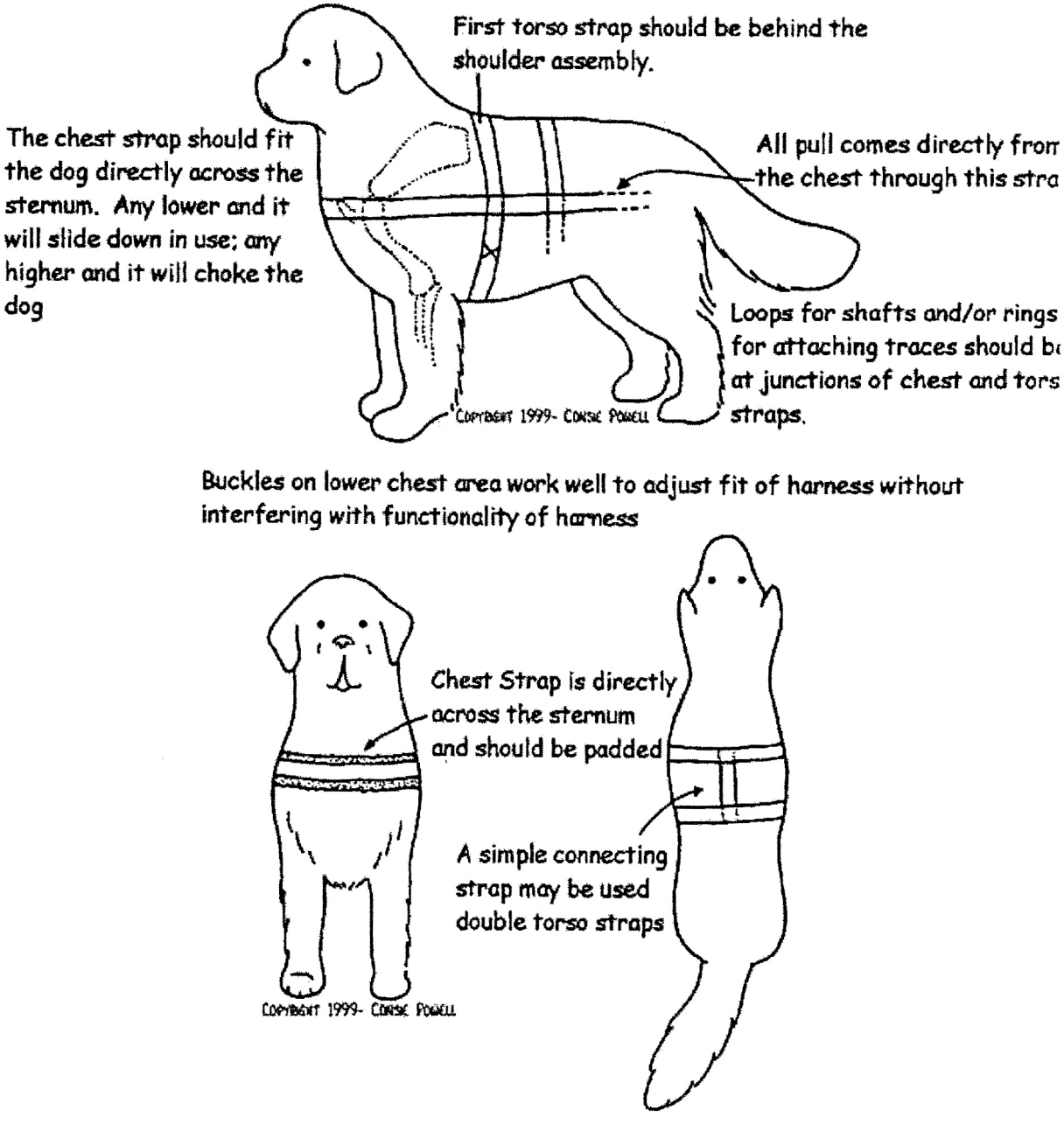
The entire shoulder assembly of the dog is completely unrestricted by the harness.
The pull on both straps is equal, distributing the stress through the padded collar.
The straps make a wide cross at the withers.
Collar is padded from chest to withers. Edges of neck strap butt together for extra width on the chest strap. Straps divide again at the front legs.

Cross-chest or Parade Harness

A harness with a cross-chest strap can be suitable for flat level terrain with only a light load. The cross-chest strap can restrict shoulder and forelimb movement. Because of its recommended limited use (that being more for exhibition than for hauling a load), it is often referred to as a 'parade harness'. This harness would be an acceptable choice on a level suburban draft test course or on a parade route.

Figure 5. The Properly Fitted Cross-Chest Harness


First torso strap should be behind the shoulder assembly.
The chest strap should fit the dog directly across the sternum. Any lower and it will slide down in use; any higher and it will choke the dog
All pull comes directly from the chest through this stra
Loops for shafts and/or rings for attaching traces should b at junctions of chest and tors straps.
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Buckles on lower chest area work well to adjust fit of harness without interfering with functionality of harness
Chest Strap is directly across the sternum and should be padded
A simple connecting strap may be used double torso straps
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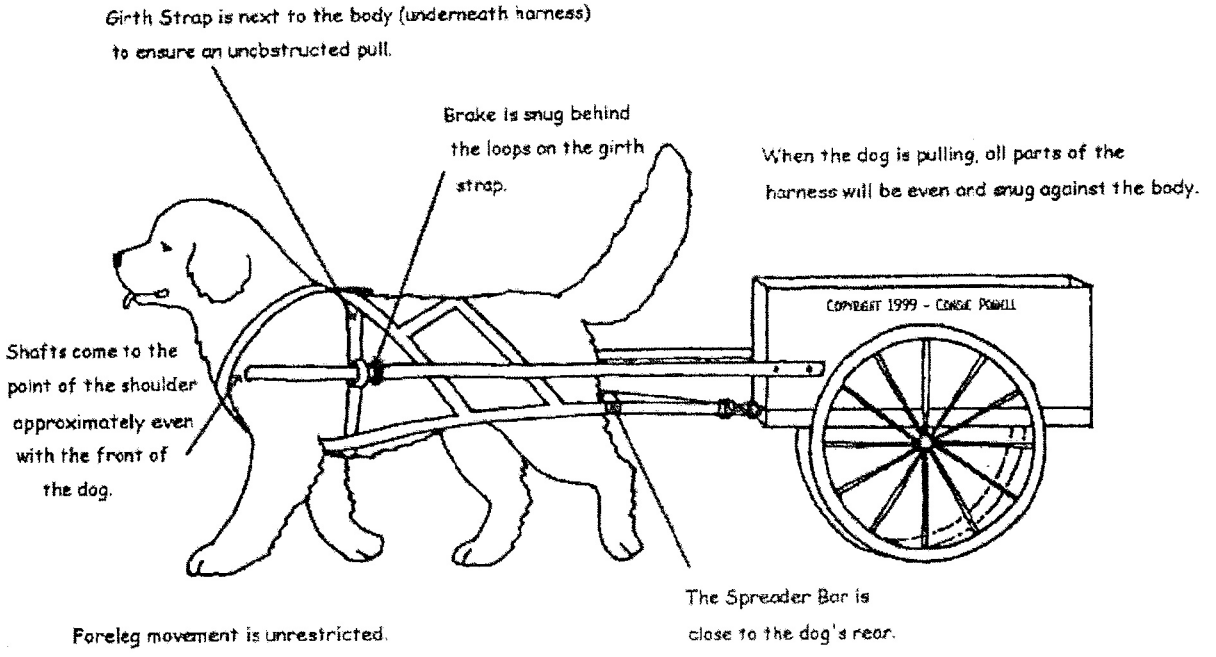
Figure 6. Siwash Harness with Spreader Bar and Single Attachment


Girth Strap is next to the body (underneath harness) to ensure an unobstructed pull.
Brake is snug behind the loops on the girth strap.
When the dog is pulling, all parts of the harness will be even and snug against the body.
Shafts come to the point of the shoulder approximately even with the front of the dog.
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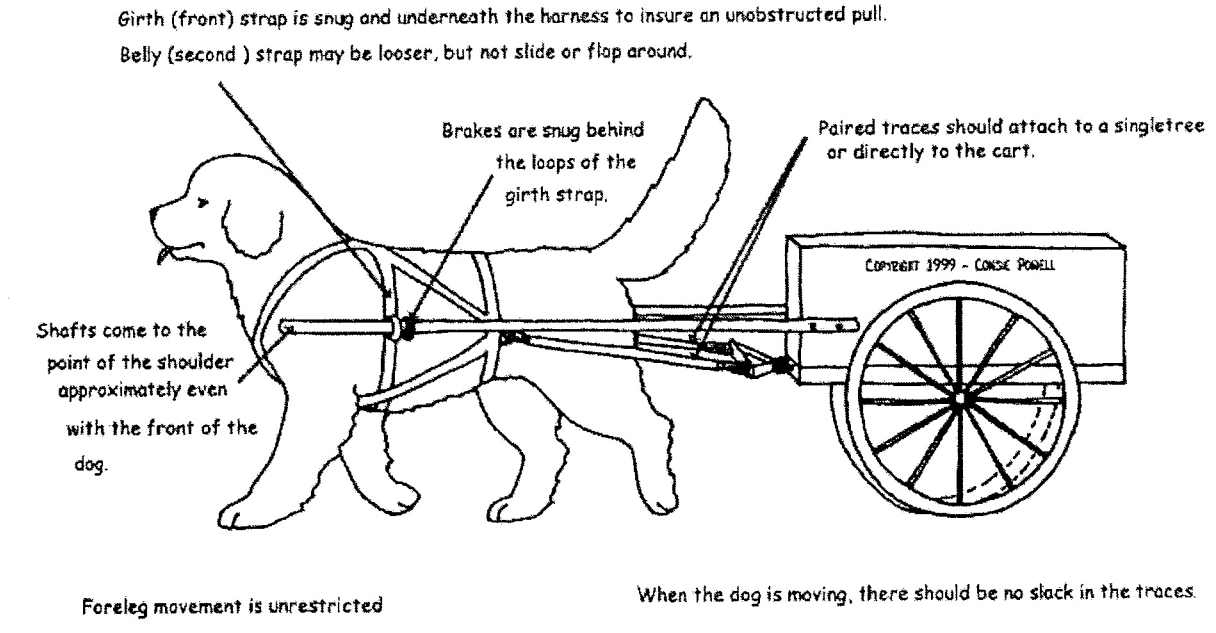
The Spreader Bar is close to the dog's rear.
Foreleg movement is unrestricted.

Figure 7. Siwash Harness with Two Traces and Double Attachment


Girth (front) strap is snug and underneath the harness to insure an unobstructed pull.
Belly (second) strap may be looser, but not slide or flop around.
Brakes are snug behind the loops of the girth strap.
Paired traces should attach to a singletree or directly to the cart.
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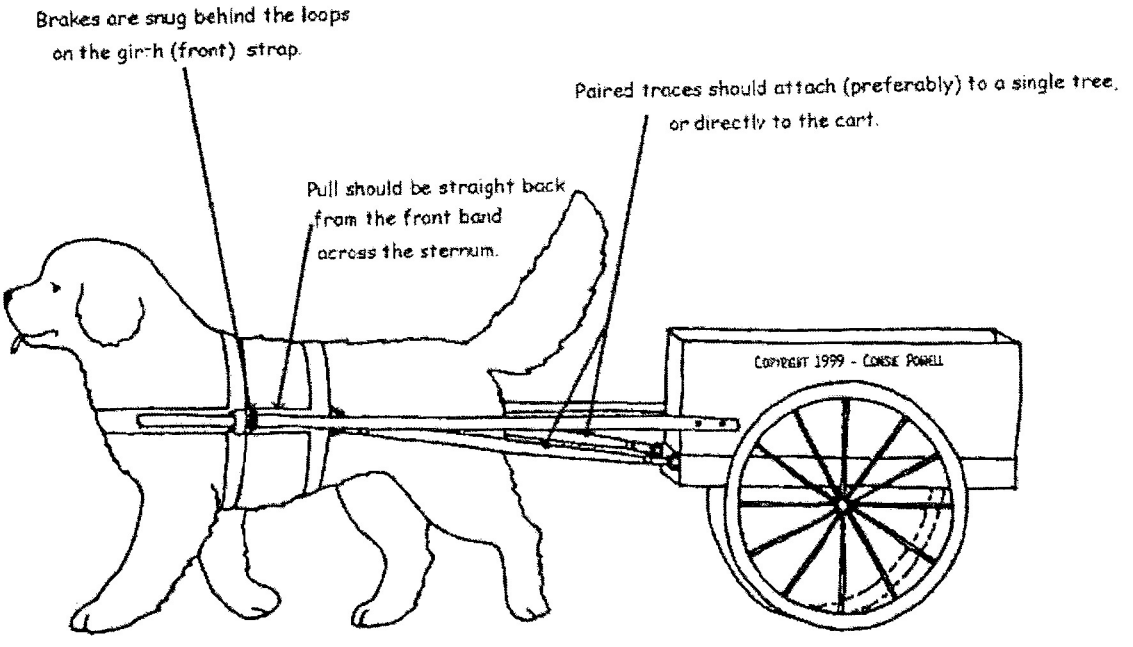
Shafts come to the point of the shoulder approximately even with the front of the dog.
Foreleg movement is unrestricted
When the dog is moving, there should be no slack in the traces.

Figure 8. Parade Harness


Brakes are snug behind the loops on the girth (front) strap.
Paired traces should attach (preferably) to a single tree, or directly to the cart.
Pull should be straight back from the front band across the sternum.
COPYRIGHT 1999 - CONNIE POWELL
Cross-chest pull is restrictive of foreleg movement and is therefore inefficient for hauling on hills.
When the dog is pulling, there should be no slack in the traces.

Equipment Checklist

Check Harness for proper fit.

Check the front at breastbone, and fit at neck. Is it too tight or too loose?

Bellyband/ Girth Strap

- Strap should be snug.
- It should be underneath the harness straps to avoid chafing and for an unobstructed pull.
- Harness and strap ends should not be dragging on the ground to create a safety hazard.

Spreader bar

- Not too restrictive, should not interfere with leg extension
- Not too loose, should not hit hocks.

Check harness for straight-line pull.

Make sure no straps are causing an interference with the harness.

The point of attachment of the harness should be in position to allow an efficient point of pull.

Is this a flat course, suitable for a parade harness?

Shafts

- Check for the point of the shoulders. Shafts should be approximately even with the front of the dog.
- Brakes should be snugly behind the bellyband loops. There should be no wasted space to cause sloppy or inefficient braking.
- The cart or wagon must stop before it strikes the dog.
- The shafts should be properly placed and adjustments made to ensure that placement.
- Check apparatus for proper balance.
- Weight should be appropriately placed so as to maintain balance.

Appropriate apparatus

- Travois - open, uneven fields or pastures
- Four-Wheeled Wagons - mostly urban settings
- Carts - most surfaces
- Sleds, Toboggans, Pulks - snowy conditions

Check Collar

There should be no tags or special collars.

Handler is prepared

Handler has the equipment necessary to repair any minor problems.

Water is available for the dogs.

Handler has a leash with them.

Poop Bags

NEWFOUNDLAND CLUB OF AMERICA, INC.

Working Dog Committee

DRAFT EQUIPMENT GUIDE

Thank you for your request for Newfoundland Club of America (NCA) Draft Materials.

Enclosed you will find a variety of materials. These include charts to help you learn about the many kinds of draft equipment available, guides to assist you in making certain types of equipment, several patterns, mail order source lists for purchasing ready-made equipment, and some basic guidelines on working with dogs in a draft capacity.

The NCA does not necessarily recommend or endorse any one of these products or designs. Our aim is to help you to choose equipment suitable to your needs so that you may enjoy working with your dog in a safe and fun manner. If you discover a training method or type of equipment not mentioned here, please let us know, so that we may expand our variety of materials. Likewise, if you encounter any particular difficulty with any of the sources listed in this packet, please also inform us.

The contents of this packet include:

Draft Apparatus
Draft apparatus comparison chart
Order sources for draft apparatus
Holt cart plans
Frederick cart plans
[redacted]
Skelton cart plans
Wagon conversion plans
Powell travois plans

Micheel wagon plans

Harnesses
Harness comparison chart
"Making Harnesses"
"The Properly Fitted Siwash Harness"
"The Properly Fitted Buckle Harness"
Order sources for harnesses

Backpacking
Backpacking Information and Order Sources
Riley backpack pattern
Powell backpack pattern

General Information
Guidelines for Training a Newfoundland for Draft Work
Order Sources for Draft Accessories and Materials
Source Guide

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GUIDELINES FOR TRAINING A NEWFOUNDLAND FOR DRAFT WORK

There is no best way to train all Newfoundlands for any kind of work, including draft work. You must find the methods which work best for you and your dog and use those methods. Remember, your dog wants to please you so your main objective in training is to get your dog to understand what you want him to do. When you discover how to communicate with your dog the rest of the training is easy.

Even though there are no best methods, the following ideas are provided in hopes that they will give some ideas to people beginning work with their dogs in front of carts, sleds or toboggans for the first time. Consie Powell's book, Newfoundland Draft Work: A Guide for Training, provides more detailed guidelines and methods for training dogs for draftwork, as well as useful background knowledge for the trainer (see Source Guide).

During all training, always praise your dog. He will respond at his best and learn to truly love his work.

Training your dog for hauling a cart, sled or toboggan cannot be started at too young an age. Your dog should first have a good grasp of basic obedience (come, sit, down, stand, stay, heel) as this will make training for draft work easier and more fun for both you and your dog. You can start your puppy on basic training as soon as you get him, even if he is hardly seven or eight weeks old. If you have never trained a young puppy before, Judi Adler's book, The Newfoundland Puppy: Early Care, Early Training, is an excellent guidebook for young puppy training, as well as being applicable for training older dogs. (see Source Guide)

For draft work training, the younger the dog, the more time should be spent at each training step. Actual hauling with substantial weight should not begin until the dog has completed most of his growth and most of his training. For a Newfoundland, substantial weight should not be pulled before the dog is at least a year old, as much growing is still going on even at this time.

The first step in draft training is getting your dog or pup used to his harness. Let him get used to it by wearing it for extended periods of time during everyday activities such as playing, sleeping and eating. Do not leave him unsupervised, however, as harnesses can easily get tangled in branches outside, furniture inside or even a puppy's legs. Bad experiences can cause a puppy to fear his harness or to enjoy chewing on it, neither of which is desired. When the dog is totally accustomed to wearing his harness, get him used to the feel of a slight drag. Attach ropes to the harness and let him wander around until he is totally accustomed to the drag. Again, supervision will be necessary to prevent tangling. Progress to a drag of a light weight. Attach a small, light weight such as a cardboard mailing tube or a branch to the ropes. Get your dog used to hauling this light weight without being frightened by the drag and noise behind him. You might want to play with your dog to help him get used to the drag; running games can be lots of fun as long as you keep an eye out for tangling. When your dog accepts the harness, the ropes and the drag, he is ready to progress to the cart, sled or toboggan.

Before actually hitching the dog to the draft apparatus, introduce him to it. Let him smell it, walk around it, see and hear you move it, and accompany you as you move it. Be sure the dog has the chance to fully overcome any apprehensions he may have about being near the draft apparatus.

Once you have taken the time to carefully introduce him to it, hitch your dog to the empty draft apparatus. Do not surprise your dog; be certain he knows what you are doing. Have your dog on lead at this time, or have a friend helping, so one of you can guide him by the collar so that he will not become apprehensive and uncontrolled. Start your dog moving slowly and never let a sled or toboggan bump him from behind and scare him. Dogs pulling carts must learn to turn with shafts at their sides. This may take time and slow, cautious progression in your training to keep from startling or discouraging your dog. As your dog becomes accustomed to the hauling, you may increase the lead and speed. Remember, a pup should never pull a heavy load. Some dogs will take to hauling naturally and quickly, others will be more apprehensive and gain confidence slowly. Be patient in your training and have fun.

As you and your dog work together to gain skill and control in hauling the empty draft apparatus, another important part of training should be taking place. Any dog which is going to do any kind of hauling must be properly conditioned, physically. The dog should be healthy, lean, and well muscled, and possessing agility and stamina. As you train your dog over the months, part of your training should include conditioning. Conditioning is fun -- jogging, vigorous games of fetch, swimming, long walks -- any and all are ways of keeping your dog in good working condition. One caution, however -- work into conditioning gradually, and build up the level of stamina over a period of time. A fun and rewarding way to accomplish this gradual conditioning is for you and your dog to exercise together. Keep it happy and fun!

Safety

While doing draft training and work with your dog, always keep safety in mind first. An uncontrolled draft apparatus and untrained dog can cause injury to the dog, you, non-involved observers and property. First, always use common sense. Next, do not rush into anything. Take each training step slowly and enjoyably; do not rush training. Always be careful of the load your dog is hauling. Do not force your dog to haul a load which is heavier than that appropriate for his conditioning. The least this can do is discourage your dog, and overloading your dog can cause pulled muscles and tendons and other injuries. If your dog balks, pay attention; he's trying to tell you something.

NCA Draft Related Activities

If, after you and your dog have reached a level of expertise at hauling, you find you are interested in more than your around-home activities, you may be interested in NCA's Draft Tests or Specialty Carting. Specific descriptions are available in the NCA Draft Test Regulations and Specialty Cart & Wagon Exercises (see Source Guide).

SOURCE GUIDE

Adler, Judi. 1982. The Newfoundland Puppy: Early Care, Early Training. 2nd edition. Available for $16.50 from Judi Adler, 12320 SW Malloy Way, Sherwood, Oregon 97140.

Elliot, Rachel Page. 1973. Dogsteps: Illustrated Gait at a Glance. Howell Book House, New York.

Lemos, Dr. Edward J. 1978. "Jogging Dogs". American Kennel Gazette, Volume 95, Number 10, pp. 32-34, (October).

Lyon, McDowell. 1974. The Dog in Action. Howell Book House. New York.

NCA Working Dog Committee. "NCA Draft Test Regulations and Specialty Cart & Wagon Exercises". Available for $2.00 (payable to NCA) from Joyce Echon, Publications Secretary, Post Office Box 142, Stevens Point, WI 54481.

Pearsall, Margaret E. 1973. The Pearsall Guide to Successful Dog Training. Howell Book House, New York.

Powell, Consie. 1987. Newfoundland Draft Work: A Guide for Training. 2nd edition. Available for $15.00 from Consie Powell, 5208 Olive Road, Raleigh, NC 27606.

Riley, Alan. 1987. Taking Your Dog Backpacking. 2nd edition. Published by the Newfoundland Club of America. $10.00, payable to NCA. Available from Joyce Echon, Publications Secretary, Post Office Box 142, Stevens Point, WI 54481.

Riley, Alan. 1980. "Backpacking with Your Dog". American Kennel Gazette, Volume 97, Number 7, pp. 38-45, (July).

Rowell, Victor. Weight Pulling for Sled Dogs. Available for $3.95 from Tundra, 16438 96th Avenue, Nunica, MI 49448.

Saunders, Blanche. 1946. Training You to Train Your Dog. Doubleday & Co., Garden City, New York.

Thompson, Raymond. Cart and Sled Dog Training. Available from Raymond Thompson So., 15815 2nd Place West, Lynnwood, Wash. 98036.

Powell, Consie. 1986. "Understanding Draft Equipment". Newf Tide, Volume 17, Number 3, pp. 46-49, (Fall).

ORDER SOURCES FOR DRAFT APPARATUS

Adirondack Dog Sled, Mfg Marshall, F. Fish Westport, New York 12993 518-962-4897	Dog sleds
Black Ice 11225 County Road 20 Delano, Minn. 55328	Dog sled Training rigs
Cannondale 35 Pulaski Street Stamford, Conn 06902 203-359-1705	Bike carts
The Digas Company 10278 White Road Linden, Michigan 48451 313-735-5409	Carts
Dog Works, Inc Box 317, RR3 Curvin Circle Stewartstown, Penn 17363 800-787-2788 717-993-6644	Carts Wagons
Hall Sleds & Rigs Frank Hall 5875 McCrum Road Jackson, Michigan 49201 517-782-1786	Dog sleds Training rigs
Horse & Pony Wagons 14107 C. R. 42 Millersburg, IN 46543 219-642-3794	Dog, goat, pony llama, and horse wagons
Kimiluk Fred Robertson Stanstead, Quebec 819-876-2817, 876-2579	Dog sleds
Konari Outfitters PO Box 752 52 Seymour Street Middlebury, VT 05753 802-388-7447	Dog sleds Pulks
li'l mor enterprizes Lisa Morauer 7247 Mill Runn Drive Derwood, Maryland 20855 301-258-8979	
Lynchburg Hardware and General Stora Lynchburg, Tenn 37352	Solid oak farm wagon
Maas Products Mfg 486 Elysian Road Petaluma, CA 94952 707-795-4844	"Silverado dog cart"
Maritime Carts & Wagons Tim & Sharon Alberts 3226 Bellevue Toledo, Ohio 43606 410-474-3147	Ready- and custom made wood carts and wagons
Maxima Bruce Chambers Lindenhurst RRD #1 Yardley, Penn 19067	Dog sleds Training rigs
Dick McDonald RFD 1 Laconia, NH 03246	Dog sleds Training rigs
Mountainsmith 12790 W 6th Place Golden, Colorado 80401	Skier/snowshoer dog sled
Nordkyn Outfitters PO Box 1023 Graham, Washington 98328 206-847-4128	Dog sleds
Dale & Jeannine Patrick Tapfer Kennel Originals 8255 S. Vale Garden Road Canby, Oregon 97013 503-266-4387	Wagons
Steve Starkovich 6 West Chapman Street Ely, Minnesota 55731 218-365-5158	Dog sleds
Frank Thompson Rt 3 More, Minnesota 55051	Dog sleds Training rigs
Tundra 16438 96th Avenue Nunica, Michigan 49448 616-837-9726	Dog wagons Dog sleds Training rigs
Von Russ Giants Harry Russ 123 Yeager Avenue Forty Fort, PA 18704 717-288-0735	Cart

DRAFT APPARATUS COMPARISON

12·12·86

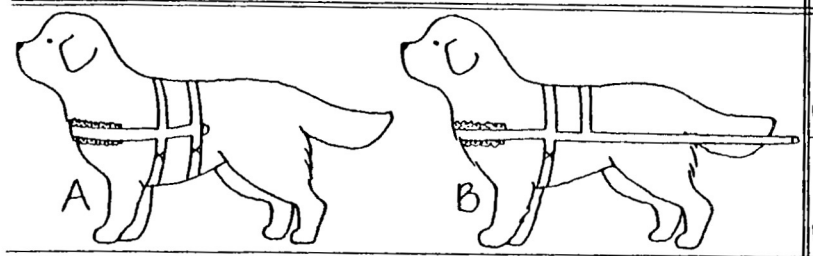
TYPE OF DRAFT APPARATUS	MODEL FOR CONSTRUCTION OR RETAIL ORDER SOURCE	APPROX. COST	FABRICATION: HOMEMADE, PARTIAL, OR PURCHASED	GROUND CONDITIONS ON WHICH APPARATUS WORKS BEST	ADVANTAGES	DISADVANTAGES	CONVERTABLE (MULTI-USE)	CAN BE USED WITH MORE THAN 1 DOG	NEEDS ADAPTATION FOR MORE THAN 1 DOG	PATTERN FOR CONSTR. ENCL.	ORDER INFO. ENCL.
2-wheeled cart	Polson model		homemade	asphalt, hard surfaces	built from inexpensive materials, bike tires	Balanced load imperitive for dog to haul 2-wheeled cart	no	no	—	✓	
2-wheeled cart	Holt model	.....	homemade	asphalt, hard surfaces	lightweight, well-balanced	balanced load imperitive for dog to haul 2-wheeled cart	no	no	—	✓ Holt	✓ Morauer
	Morauer model ...	.....	purchased								
2-wheeled cart	von Russ Giants Utility Wagon	$100.00	purchased	asphalt, hard surfaces	easy to maneuver	does not ride people too well. Balanced load imperitive for dog to haul 2-wheeled cart	yes (runners for snow)	no	—		✓
2-wheeled cart	Digas cart	$150.00	purchased	asphalt, hard surfaces	well-balanced, easy to maneuver	designed mostly to ride people not other loads. Balanced load imperitive for dog to haul 2-wheeled cart	yes (runners for snow)	no	—		✓
4-wheeled wagon	Lynchburg oak farm wagon; Horse & Pony wagon	$400.00 - 500.00	purchased	asphalt, hard surfaces	well-made, very classy in appearance.	fairly expensive	no	yes	yes		✓
2-wheeled cart	Hannibal Knls	$300.00 - $350.00	purchased	asphalt, hard surfaces	lightweight, well-balanced, easy to maneuver. Available in standard or heavy-duty models.	designed mostly to ride people, not other loads. Balanced load imperitive for dog to haul 2-wheeled cart	yes (runners for snow)	no	—		✓
2-wheeled cart	Bicycle cart, converted	$100.00	partial	asphalt, hard surfaces	lightweight	has tendency to tip if load not carefully balanced over wheels	no	no	—		✓
4-wheeled wagon	Skelton model	$100.00	homemade	asphalt, hard surfaces	solid, steady, low to ground for stability. space for people and load		yes (runners for snow)	yes	yes	✓	
4-wheeled wagon	Frederici wagon; Micheel wagon		homemade	asphalt, hard surfaces	has springs for very smooth ride. Classy in appearance		no	yes	yes	✓	
4-wheeled wagon	Child's wagon, converted	$40.00 - $65.00	partial	asphalt, hard surfaces	lightweight, fairly inexpensive Revisions to convert wagon for hauling fairly easy	Lacking in efficiency. Poor center of balance when loaded.	no	depends on model	yes	✓	
3-wheeled sled training rig	training rig	$250.00 - 350.00	purchased	hard surfaces	wheeled, braked rig can be used for training dogs for sled work in non-snow seasons.	heavy rig - best used if working multiple dogs	no	yes	no		✓
small sled	child's sled		purchased	packed snow, rough ice	inexpensive, easily accessable. Good for play.	cannot be used off packed surface. Minimal control and load carriage.	no	yes	no		
medium sled	Mountainsmith Harness sled	$150.00 - $200.00	purchased	packed snow, rough ice. Works also in loose snow	Rugged, lightweight, quite versatile. Can also be hauled easily by person on skis or snowshoes	Presents more drag on packed snow than runner sleds. Has no steer/brake mechanism	no	yes	yes		✓
large sled	racing or standard dog sled	$250.00 new $100.00 used	purchased	packed snow, rough ice	minimal drag on packed surfaces. Can be steered, has brake. Handler can ride.	cannot be used efficiently off packed surface.	no	yes	no		✓
toboggan	toboggan		purchased	packed snow, rough ice. Works also in loose snow	can go on more loosely packed snow than sleds, follows snowshoe trails.	presents more drag on packed snow than sleds. Has no steer/brake mechanism.	no	yes	no		
travois	Powell model	$20.00	homemade	hard surfaces, trails (non-paved areas) grass	carries bulkier load than dog could backpack into areas carts can't go. Traverse sled, toboggan trails in non-snow seasons. Disassembles.	not designed to haul people		no	—	✓	

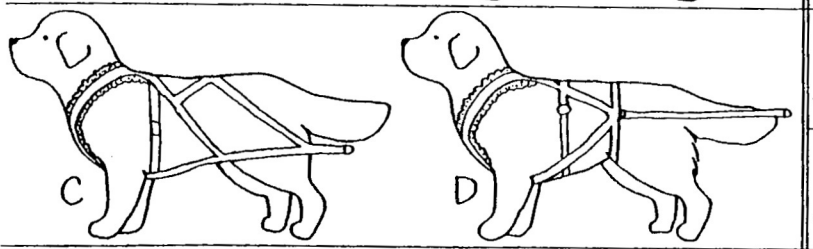
HARNESS COMPARISON CHART 8/90

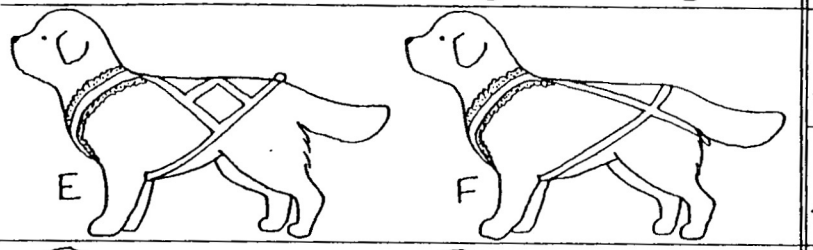
This chart shows general harness styles. Some can be bought or ordered, and all can be homemade with care and precision for proper fit (see sheet on: "Making Harnesses")

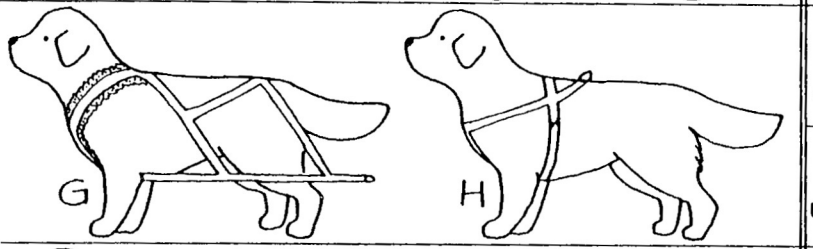
HARNESS STYLES

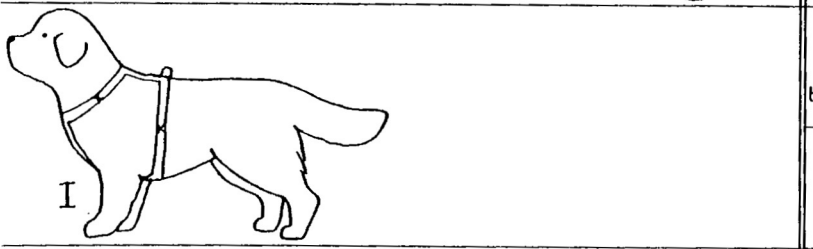
▭ = padding
x = buckles
D = attach for hauling











HARNESS STYLE:	MAY BE USED FOR:	BEST USED FOR:	ADVANTAGES	DISADVANTAGES	APPROX. COST	MAY BE ORDERED FROM:	ORDERED HARNESSES MADE OF:
A buckle-on	cart wagon tracking	cart wagon	simple design somewhat adjustable because of buckles comfortably worn when not actually hauling	cross-chest/shoulder pull contrary to efficient function of dog	$10.00 – $45.00	Digas Hannibal	leather
B buckle-on	cart wagon light sled & toboggan	cart wagon	simple design somewhat adjustable because of buckles	cross-chest/shoulder pull contrary to efficient function of dog	$10.00 – 15.00	von Russ Giants	leather
C slip-on	cart wagon travois	cart wagon	maximum efficiency for function of dog while hauling	fit can be marginal unless harness is custom made. not versatile for wear when not hauling.	$30.00*	Beth Edge Newf Novelties Dog Works	nylon web
D slip-on	cart wagon travois	cart wagon travois	very efficient for function of dog while hauling; comfortably worn when not actually hauling; adjustable traces		$30.00	[redacted] Nordkyn Dog Works	nylon web
E slip-on	sled toboggan	light sled & toboggan	comfortably worn when not actually hauling	pulls down on croup on large breed dogs	$10.00	Nordkyn Katmai Zima Konari	nylon web
F slip-on	sled toboggan	sled toboggan	comfortably worn when not actually hauling construction is all one piece for maximum strength	pulls down on croup on large breed dogs, but not as much as E.	$15.00	Tun-Dra	nylon web nylon web
G slip-on	sled toboggan	heavy sled & toboggan	best for very heavy hauling	least versatile when not hauling	$25.00	Nordkyn Zima Konari	nylon web
H buckle-on	tracking	tracking	simple design somewhat adjustable		$6.00		nylon web
I buckle-on	tracking	tracking	simple design somewhat adjustable		$10.00	Nordkyn	

MAKING HARNESSES (also good things to know before buying a harness)

Before you prepare to make a harness for your dog, you should do several things:

First, carefully study the harness comparison chart. There are three basic styles of harnesses: buckle styles (A,B) are used primarily for cart hauling; modified siwash styles (C,D,E,F,G) are used primarily for sled and toboggan hauling, with selected styles appropriate for cart and travois hauling; and tracking harnesses (H,I) are used primarily for tracking work and are usually not appropriate for hauling.

Second, decide which style of harness best fits the kind of draft work you want to do with your dog. If you already have your draft apparatus, choose a style of harness which will work best with that apparatus. Many harnesses are appropriate for varying kinds of draft work, while others will function optimally only for a very particular kind of work. Keep this in mind when choosing a harness style.

Finally, once you have decided on the style of harness you want to make, familiarize yourself with how that harness should fit. Proper fit is imperitive, and only through proper fit will the harness function correctly to best enable your dog to work efficiently and avoid injury.

Making the pattern

The major step in making a harness for your dog is to make a pattern. Don't skip this step! In making a pattern, you can insure proper fit, and also determine the appropriate quantities of materials needed. To make your pattern, use strips of non-stretchable cloth or ribbon cut to a comparable width (1" wide is a good standard width) of the material from which you will make your finished harness. Fit the strips onto your dog as shown in the harness style illustration; pin, baste, adjust, and readjust as much as necessary to attain proper fit. Once your pattern is all basted together, pull firmly on it, against your dog, from the point where it will attach to the hauling apparatus. Make sure that when pulled the harness still fits properly, puts stress at the appropriate areas of the dog's anatomy (feel your dog - know where the shoulder blades and breastbone are) and does not put improper stresses elsewhere. If necessary readjust until the perfect fit is attained. Once you are certain that you have a perfect fitting pattern, you can put together your final harness carefully following the pattern you have made. Be certain to try your basted final harness on your dog before doing the finishing work.

Important points to remember in making (or buying) a harness

BUCKLE STYLE HARNESSES (A,B)

Buckle style harnesses must have a front chest strap from which the main pulling stress is directed. Make sure this strap is high enough to be solidly across the dog's wide chest, but not so high as to be on the dog's neck where it could choke the dog. It is advisable to have at least one complete torso strap to keep the chest strap stationary. Additional straps may be added to enhance fit, but must not interfere with the dog's movement while hauling. Buckles should be located where they will not chafe or interfere with the dog's movement. Snap rings, loops for shafts, and any other desired details can be added accordingly, depending on the type of draft

apparatus to be used, but must keep the pull coming from the front chest strap. The front chest strap should be padded.

MODIFIED SIWASH STYLE HARNESSES (C,D,E,F,G)

Siwash style harnesses feature a "collar" which fits snugly around the dog's shoulders to form a flexible ring of force at the base of the dog's neck. A double width chest strap comes down from this collar to separate into two straps which go between the dog's forelegs. It is through these straps and straps coming off the top of the collar that the weight being pulled is carried from the dog's chest and shoulders. Make sure the pull from the collar to the point of attachment to the draft apparatus is evenly distributed through the harness. In all styles make sure there is no extra slack or tight pull in the harness. The neck collar and wide chest strap on siwash harnesses should be padded. Modified siwash harnesses slide on the dog; they do not buckle. The harness should be a fairly snug fit, without chafing.

TRACKING HARNESSES (H,I)

Tracking harnesses are basically designed for keeping hold of a dog, not for use in hauling. The harness should comfortably, but firmly surround the neck, shoulders and front torso, while leaving the front assembly of the dog unrestricted in movement. This style harness buckles on to insure a firm fit. A ring or clasp on the harness on the dogs back provides an attachment for a lead.

Suggested materials for harnesses

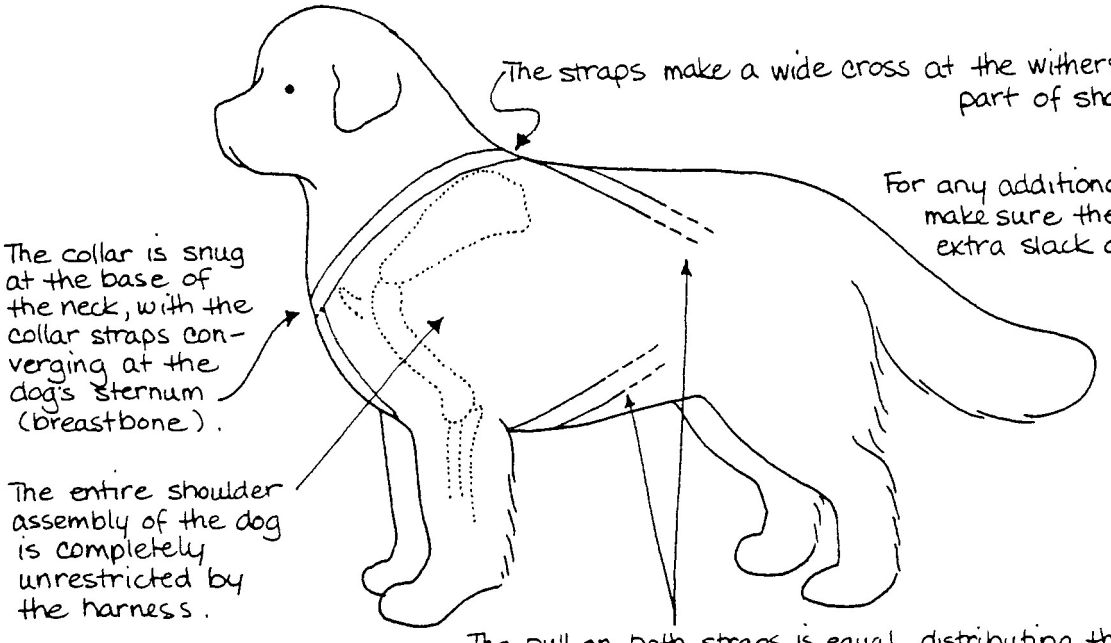
Wide nylon or cotton webbing (awning, seatbelt webbing) - washable
1" nylon webbing (best for siwash styles) - washable
Leather

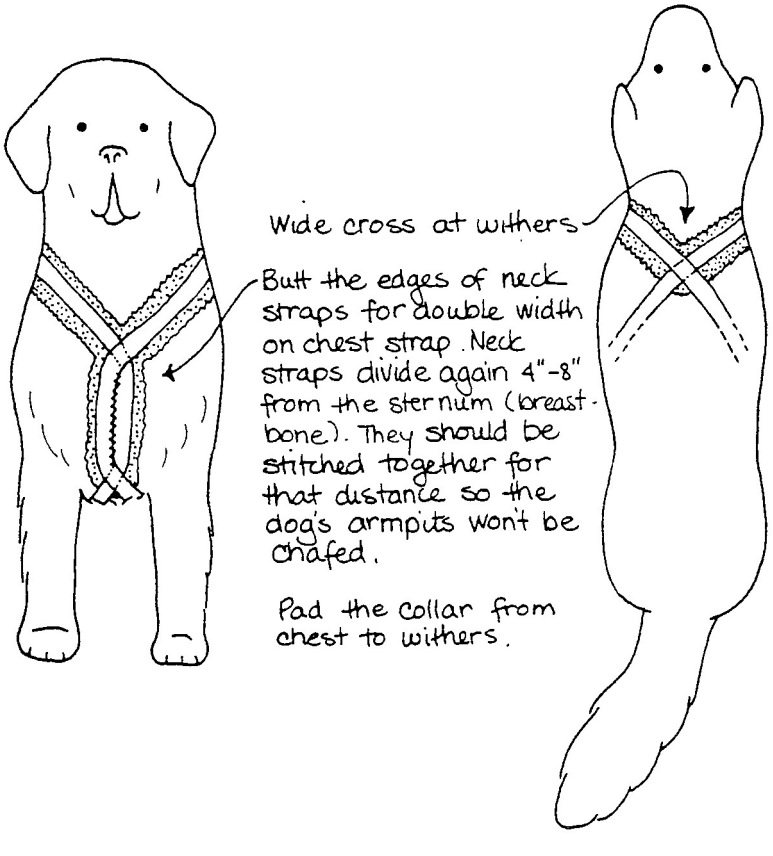
Padding:
- Fake fur - washable
- Thin foam material - washable
- Sheepskin

Heavy thread if sewing
Rivits if using leather

THE PROPERLY FITTED SIWASH HARNESS

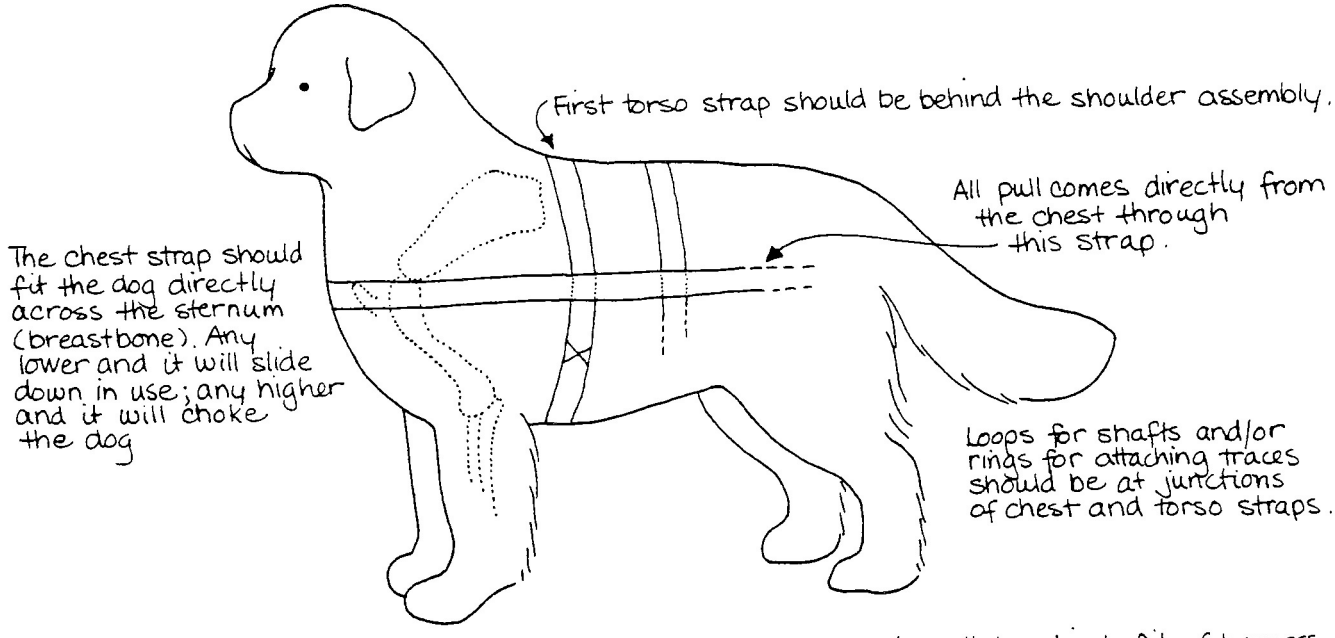
1" wide webbing (or other material) works best
A ring or rope loop may be attached at end of harness for attaching to traces for draft apparatus.


The straps make a wide cross at the withers (highest part of shoulder)
For any additional back straps make sure there is no extra slack or tautness.
The collar is snug at the base of the neck, with the collar straps converging at the dog's sternum (breastbone).
The entire shoulder assembly of the dog is completely unrestricted by the harness.
The pull on both straps is equal, distributing the stress through the padded collar. Attach straps together, keeping pulling stress even, at that point on height of dog most practical for the apparatus being pulled.

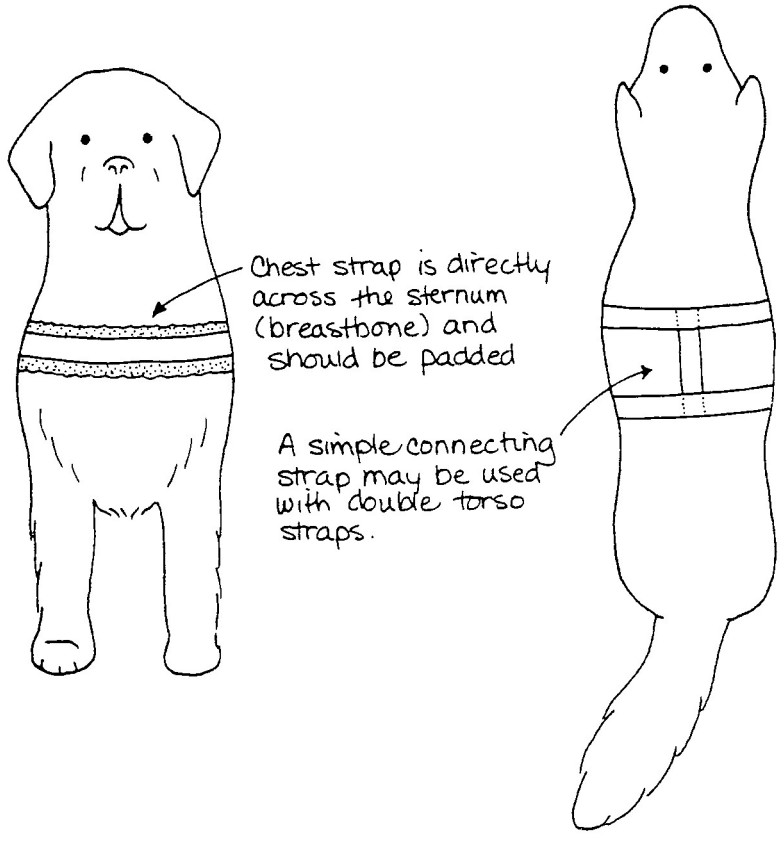

Wide cross at withers
Butt the edges of neck straps for double width on chest strap. Neck straps divide again 4"-8" from the sternum (breastbone). They should be stitched together for that distance so the dog's armpits won't be chafed.
Pad the collar from chest to withers.

THE PROPERLY FITTED BUCKLE HARNESS

1" or wider (up to 2 1/2") webbing or material works well.


First torso strap should be behind the shoulder assembly.
All pull comes directly from the chest through this strap.
The chest strap should fit the dog directly across the sternum (breastbone). Any lower and it will slide down in use; any higher and it will choke the dog
Loops for shafts and/or rings for attaching traces should be at junctions of chest and torso straps.

Buckles on lower chest area work well to adjust fit of harness without interfering with functionality of harness.


Chest strap is directly across the sternum (breastbone) and should be padded
A simple connecting strap may be used with double torso straps.

ORDER SOURCES FOR HARNESSES

Adanac
Jack & Laurie Beckhorn
4100 Hwy 93 N
Kalispell, Montana 59901

Balck Ice
11225 County Road 20
Delano, Minnesota 55328

The Digas Company
10278 White Road
Linden, Michigan 48451
313-735-5409

Dog Works, Inc 800-787-2788
Box 317, RR 3 717-9936644
Curvin Circle
Stewartstown, Pennsylvania 17363

Beth Edge
4480 Hendershot NW
Grand Rapids, Michigan 49504

Konari Outfitters
PO Box 752
52 Seymour Street
Middlebury, Vermont 05753
802-388-7447

Maxima
Bruce Chambers
Lindenhurst RRD #1
Yardley, Pennsylvania 19067

Nordkyn
PO Box 1023
Graham, Washington 98328
206-847-4128

Tundra
16438 96th Avenue
Nunica, Michigan 49448
616-837-6486

Von Russ Giants
Harry Russ
123 Yeager Avenue
Forty Fort, Pennsylvania 18704

ORDER SOURCES FOR DRAFT ACCESSORIES AND MATERIALS

TRACES, GANGLINES:

The Digas Company
10278 White Road
Linden, Michigan 48451
(313) 735-5409

Tundra
16438 96th Avenue
Nunica, Michigan 49448
(616) 837-6486

Nordkyn Outfitters
PO Box 1023
Graham, WA 98338
(206) 847-4128

Konari Outfitters
PO Box 752, 52 Seymour St
Middlebury, VT 05753
(802) 388-7447

SLEIGH RUNNERS (for winter conversion):

The Digas Company
10278 White Road
Linden, Michigan 48451
(313) 735-5409

WEBBING AND HARNESS CONSTRUCTION MATERIALS:

Katmai Kennels
Bob and Pat Lugo
RR 3, Box 179
Milaca, Minnesota 56353

Nordkyn Outfitters
PO Box 1023
Graham, WA 98338
(206) 847-4128

Tundra
16438 96th Avenue
Nunica, Michigan 49448
(616) 837-6486

Maxima
Bruce Chambers
Lindenhurst RRD #1
Yardley, PA 19067

Eastern Mountain Sports, Inc.
Two Vose Farm Road
Peterborough, NH 03458

Recreational Equipment, Inc.
PO Box C-88125
Seattle, Washington 98188

In addition, materials can usually be purchased in outfitting stores, and/or tack shops, as well as hardware stores for buckles, clasps, etc.

BACKPACKING

If you plan to do any backpacking with your dog, remember, as with any kind of draft work, packing requires that you be aware of your dog's potential and limitations, and that you and your dog will be working as a team. A good source for background on backpacking with your dog can be found in the book(s) Taking Your Dog Backpacking by Alan and JoAnn Riley (see source guide). Take the time to learn the responsibilities involved with packing with a dog.

In procuring a pack for your dog, there are several important things to remember:

1) the pack must fit the dog well
2) the pack must not impede the dog's movement
3) the pack stays in place well
4) the pack is durable
5) the pack comes on and off easily

Enclosed are two different patterns for making dog backpacks. The Riley version is a vest-style pack, and the Powell version is a harness/packbag combination (which can also be made all in one piece, if desired). These packs cost approximately $15.00 to $20.00 to make.

Below are listed companies from which ready-made or kit-form dog packs may be ordered. Dog packs can also often be found in outdoor/outfitting stores. Prices range from $15.00 to $35.00.

Tundra
16438 96th Avenue
Nunica, Michigan 49448
(616) 837-6486

Nordkyn Outfitters
PO Box 1023
Graham, WA 98338
(206) 847-4128

Eastern Mountain Sports
Two Vose Farm Road
Peterborough, New Hampshire 03458
(603) 924-7276

(pack kit)
Frostline Kits
Frostline Circle
Denver, Colorado 80241
(303) 451-5600

Hannibal Kennels, Newfoundlands
Peter Maniate
PO Box 933, Station F
Toronto, Ontario
M4Y 2N9 Canada

Konari Outfitters
PO Box 752, 52 Seymour St.
Middlebury, VT 05753
(802) 388-7447

RILEY BACKPACK PATTERNS

designed by
Alan and JoAnn Riley

Two pack patterns, with instructions for construction are included. One, a day pack, is adequate for a two or three day outing provided the dog does not have to carry his own water. The other is a freight pack that is best for longer outings as it has larger pockets and more tie-on rings. It too can serve as a day pack but is unnecessarily bulky for most outings. The materials recommended in the instructions are adequate only for modest loads.

Both packs are built on the same principle of two pockets attached to a snug-fitting vest. Adjustable straps make handling easy. Once the straps are set all you need do is attach the snaps to the rings after placing the pack on the dog.

It is important to be aware that pockets filled with water are heavy and hard to move against swift currents. Learn to judge how much drift to expect. Enter water well above the point on the other side where the dog is expeced to land. Pack gear to protect it from water.

When starting out make sure the load is balanced. If not, it swings over to one side and hampers the dog's movement. Balance it by placing a smooth rock or two into the pocket on the lighter side. Any hard-edged objects should be packed in such a way that they will not dig into the dog's ribs.

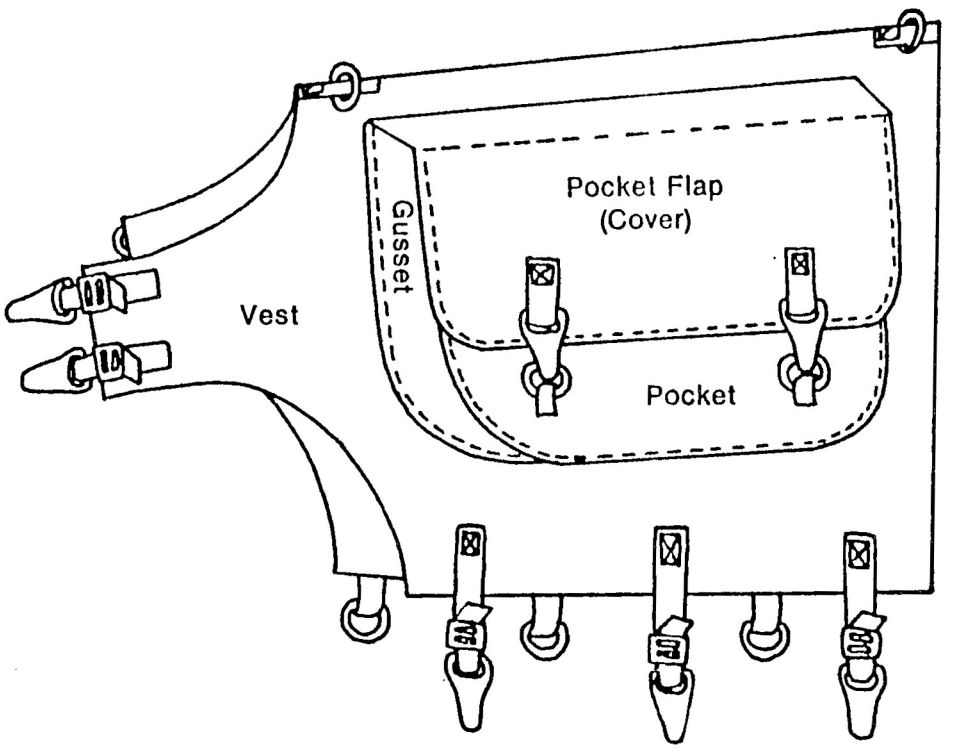
PACK CONSTRUCTION

Dimensions of the pack and yardage required will depend upon the size of the dog. It is recommended that a pattern be made from old sheets or paper and fitted to the dog before buying fabric and cutting into it. The following materials will be needed:

Plastic-coated nylon taffeta pack cloth
¾ inch webbing—cotton or nylon
¾ inch harness snaps (9 for day pack, 13 for freight pack)
¾ inch "D" rings (10 for day pack, 19 for freight pack)
¾ inch adjusting buckles (9 for either pack)
Cotton bias tape
Heavy duty cotton or polyester thread
4 grommets (two placed at the bottom of each pocket to drain water)

Pattern pieces include:

Vest
2 pockets
2 gussets
2 pocket covers for day pack
1 pocket cover for freight pack (single piece used for both pockets)



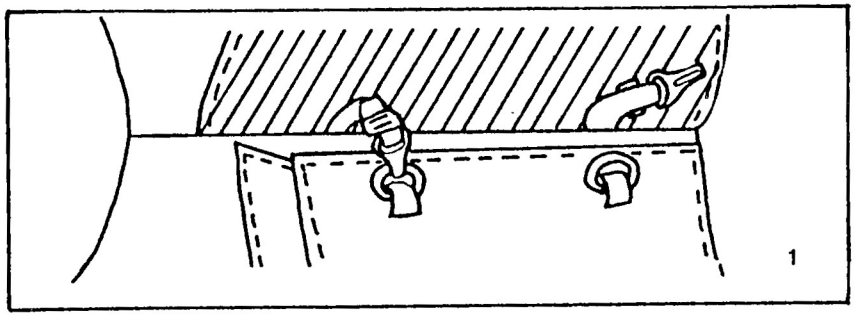
DAY PACK

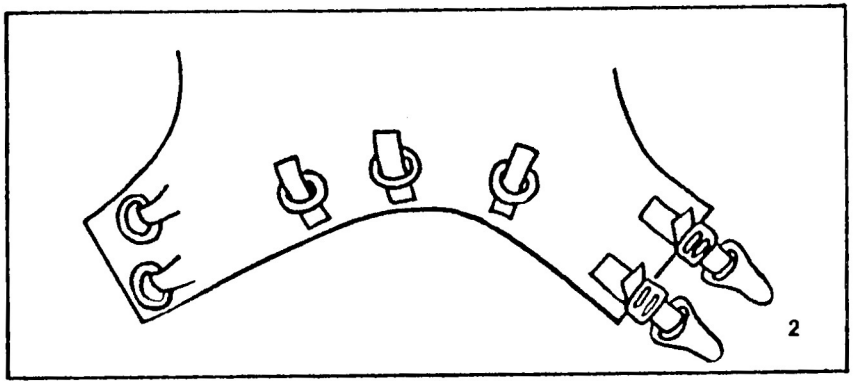
INSTRUCTIONS FOR ASSEMBLY

GENERAL SUGGESTIONS:

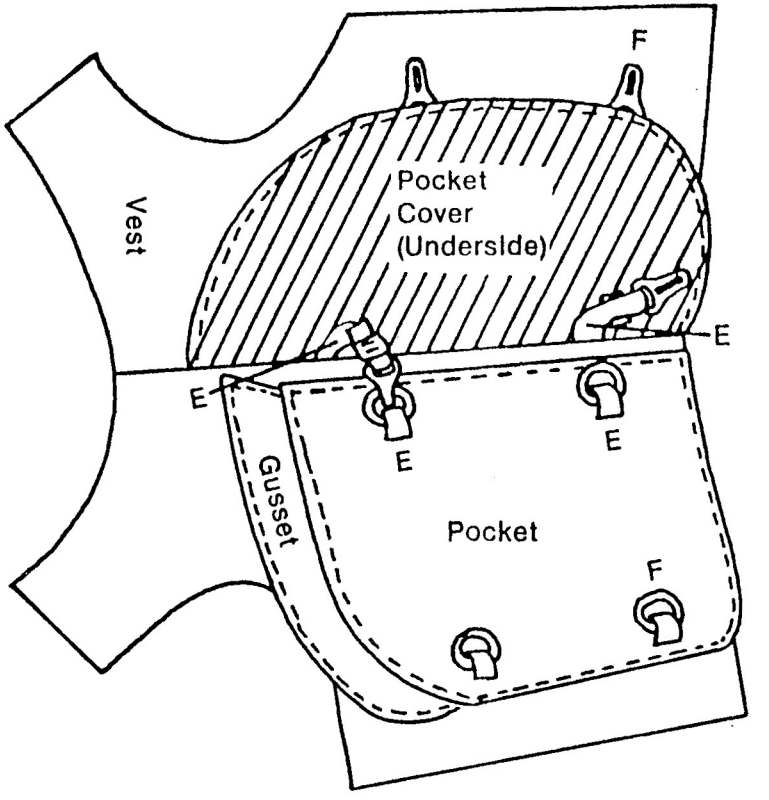
1. Look over illustrations to get an idea of how the pack goes together.
2. Hems need to be turned under just once as this material does not ravel easily.
3. At all "corners" where two pieces of material are joined, reinforce with rivets or stitch as shown.
4. When attaching straps, cut a scrap of fabric to place under the strap on the wrong side of the pack and stitch into place with the strap as a reinforcement. Stitch straps in place using the pattern shown in the strap detail illustration.

(1) Detail of pocket from freight pack showing the pocket top supporters. Located under the pocket flap the supporters prevent the pocket from sagging open when pack is in use. (2) Detail of "D" rings and fasteners from freight pack not found on the day pack, allow a sleeping bag and other equipment to be fastened down.





E-Pocket Top Supporters
F-Pocket Closures



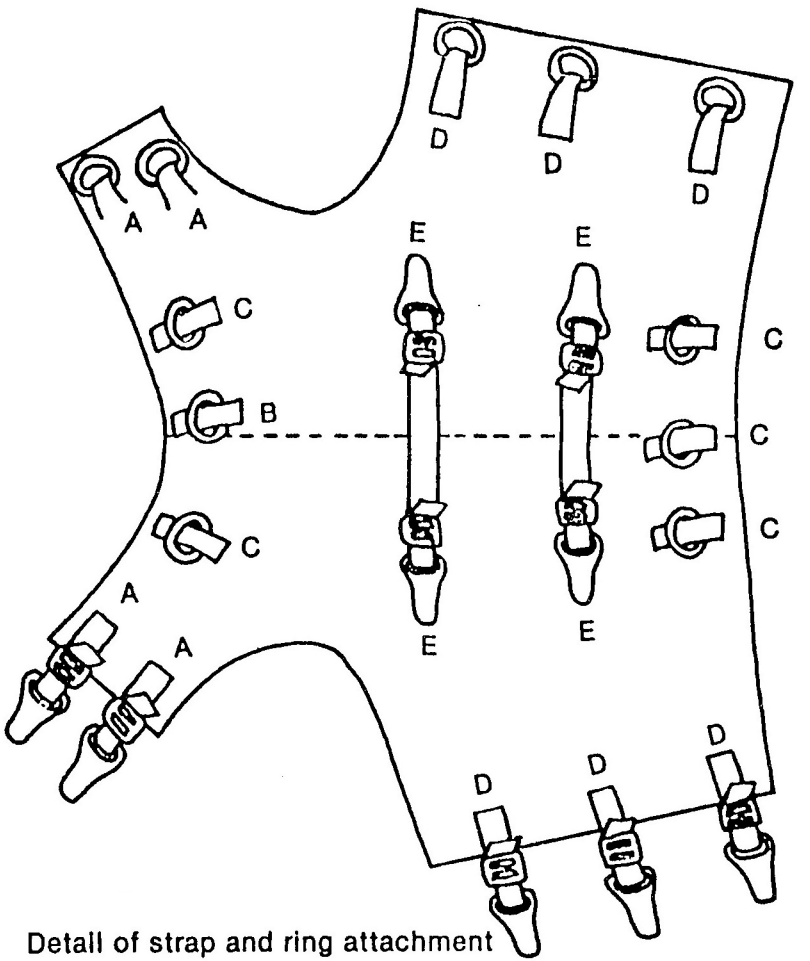
Detail of pocket and pocket cover attachment and pocket straps and rings

FREIGHT PACK

ASSEMBLY:

1. Bind raw edges of vest with bias tape.
2. Sew gusset to pocket with right sides together making a ¼ inch seam. Trim off excess gusset material even with top of pocket. Hem gusset and pocket along top edge. On right side of pocket restitch pocket-gusset seam making a ¼ inch seam.
3. Turn raw edge of gusset under ¼ inch and pin or baste. Pin in place on vest and stitch gusset to vest making a ¼ inch seam. Repeat steps 2-3 for second pocket.
4. Hem pocket cover (2 separate covers for day pack)
   A. *For day pack:*
      Stitch pocket cover to the vest even with the top of pocket. It should be slightly wider than the pocket. Fold pocket cover 4 inches from, and parallel to, this seam and stitch a 1/8 inch seam along the fold of the right side. This will allow the pocket cover to lie flat across the pocket opening and fold down flat over the pocket. Repeat with second pocket cover.
   B. *For freight pack:*
      Fold vest in half along the line of the spine and crease. Open vest and lay out flat. Place two strips of webbing about 20 inches long across crease about 6 inches apart. (See pack illustration strap). Tack in place. Make crease down center of pocket cover and lay over vest, lining up cover crease with crease in vest and adjusting so pocket cover lies over either side of pockets equally. Pin or tack in place along center crease line. Then stitch pocket cover to vest along crease line. Make double seam by stitching one direction first, then back.
5. Stitch straps, rings and snaps in place as shown in pack illustration. Length of straps and distance stitched from edge of pack will depend upon the size of your dog. There should be some overlap of the vest under the chest and belly fastenings. If this amount is excessive it can be trimmed off and rebound.
6. Grommets can be put in the gusset part of the pocket bottom to drain water taken in during stream crossings. We use two grommets spaced a few inches apart in each pocket.

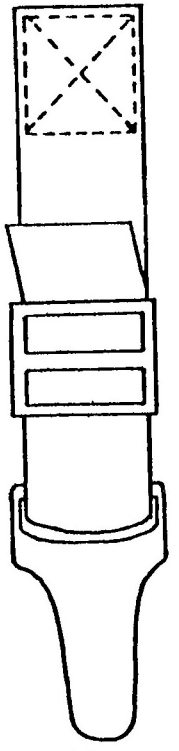
A-Chest Fastenings
B-Lead Ring
C-Rings for tying on sleeping bag
D-Belly Fastenings



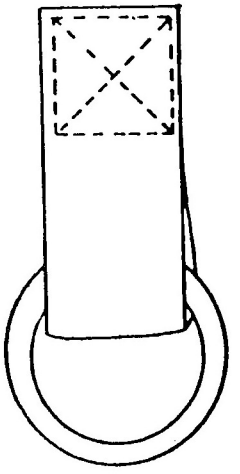
Detail of strap and ring attachment (vest only)

FREIGHT PACK

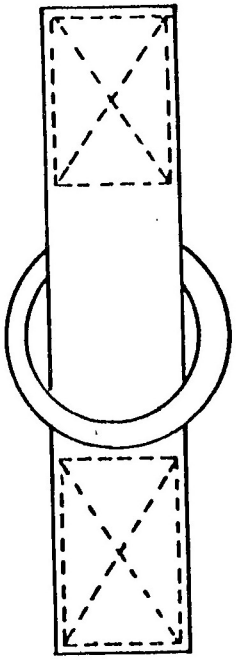
STRAP DETAIL



Strap with snap closing
and adjusting buckle



Hanging Strap with
Ring

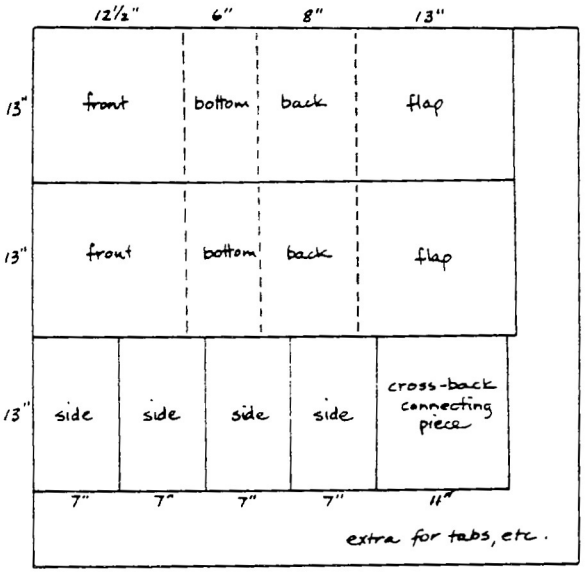


Strap stitched on both
ends with ring

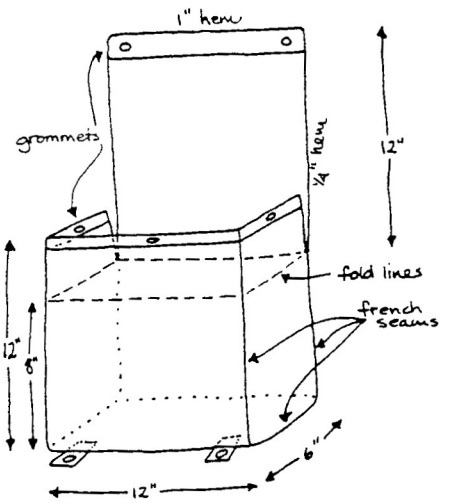
PORTAGE BACKPACK AND HARNESS

CUT-OUT MEASUREMENTS FOR PACKBAGS

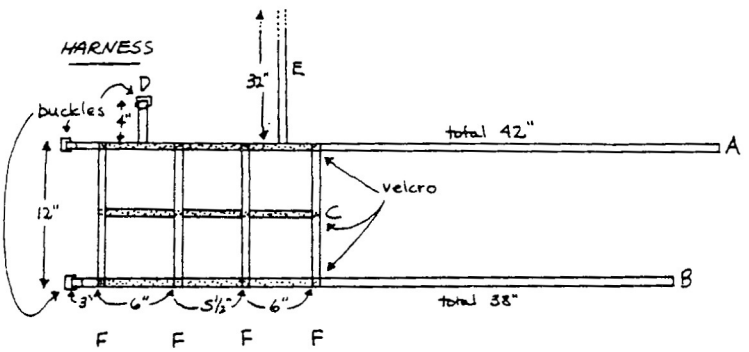
——: cut
- - - - -: fold



INDIVIDUAL PACKBAG CONSTRUCTION



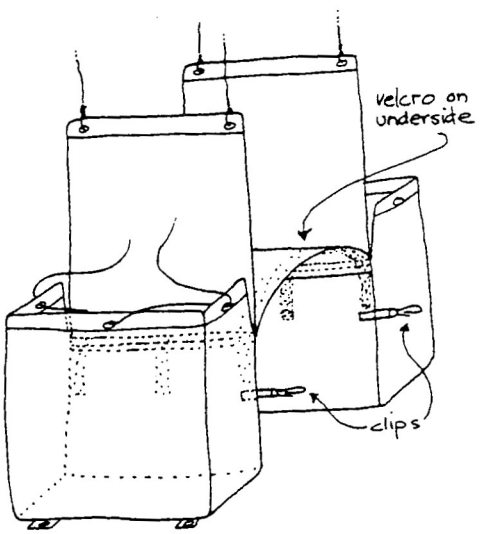
HARNESS



SCALE IN INCHES

0 6 12

* scale accurate for cut-out measurements for packbag and for harness.



COMPLETED PACKBAG.

designed by:
Connie Powell
5208 Olive Road
Raleigh, North Carolina
27606

PORTAGE BACKPACK and HARNESS

This pack is a practical piece of equipment for use when canoe camping, or doing other activities which would necessitate taking the pack off the dog, and then putting it back on again a number of times during a day's travel. The harness is comfortable and safe for the dog to wear all day (in a boat, while swimming if necessary), and the pack easily attaches and releases in a matter of seconds. (The pack and harness are also appropriate for regular all-day hiking; the pack may also be constructed in a one-piece non-harness style if preferred.)

Materials needed

1¼ yds 45" ripstop nylon, or canvas, and appropriate thread
3 1" release buckles
14 3/4" grommets (and equipment for inserting them)
nylon cord
190" 1" nylon webbing (125" if making non-harness style pack)
1½ yds 1" velcro "hook"
1½ yds 1" velcro "pile"
2 1" D-rings
2 small clips (clasps)
} not needed if making non-harness style pack

A) Construction: Packbag (make 2)

1) cut fabric as in pattern
2) Sew side pieces into front-bottom-back section. (Use french seams; sew initial seam to outside of facric so final french seam will be within pack. Seam allowance is for ¼" french seam, using approximately ½" total to sew seam. Or, bind seams, so there are no raw edges on the inside of the pack). When sewing side to front, seam completely to edge of fabric. When sewing side to back, sew seam only 8" up from bottom corner.
3) Sew ¼" hem up sides of flap portion.
4) Fold over and sew 1" hem at top of flap.
5) Sew ¼" hem up remaining raw edge of side piece.
6) Fold over and sew 1" hem at top of side-front portion of packbag.
7) Make 2 tabs, finished size 2" x 1¼" (Double fabric for strength)
8) Sew tabs approximately 3/4" fromm bottom corners of bag. Sew to bottom section of bag, leaving about 1¼" extending.
9) Put grommetts in: one in each tab, one 3/4" from each edge on hem of flap, and one each in center of front and sides.

B) Attach bags to cross-back piece:

1) Sew ¼" hem up short sides of cross-back piece.
2) Pin bags 1½" from raw edges of cross-back piece, along flap-to-back fold line of bags.
3) Lay pack over dog's back to check fit. Cross-back piece should lay fairly flat and high on dog's back, not extending over the sides. This 8" cross-back width should fit most adult dogs and bitches (Newfs). If your dog is narrower or wider, adjust the dross-back width accordingly.
4) Sew bags to cross-back piece along pin line. Then fold under raw edge of cross-back piece and sew another row of stitching parallel to the first. A third parallel row of reinforcement stitching is advisable.

C) Harness:

1) Seal all raw cut ends of nylon webbing in a flame before sewing.
2) Sew buckles to ends of 4"(D), 42"(A), and 38"(B) pieces of webbing. (When cutting webbing for D,A, and B allow 1" extra for sewing on buckle.)
3) Pin the four 12" pieces of webbing (F) on A and B at proper intervals. Sew.
4) Lay center 18" strip of webbing (C) under cross pieces. Pin. Sew.
5) Sew 4" buckle piece (D) and 32" plain piece (E) of webbing on A as shown in diagram.
6) Sew 18" velcro "pile" strips to webbing A,B, and C.
7) Sew D-rings to D and E about 1" from strip A.
8) Strip E may be padded if desired.

D) Packpack: Finishing:

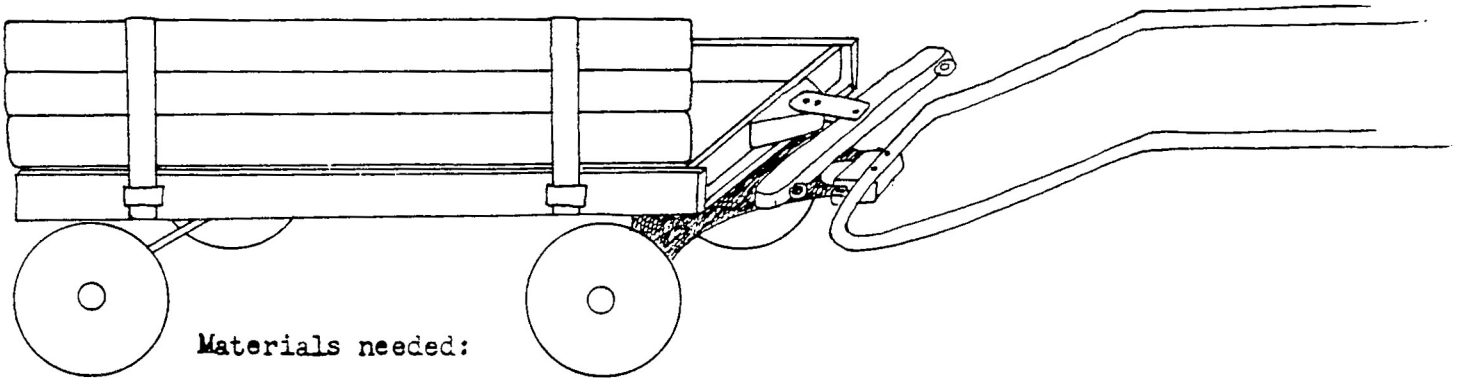
1) Sew tab, holding clasp, $4\frac{1}{2}$" up from bottom corner of packbag. (sew to back portion of bag.)
2) Cut 3 18" velcro "hook" strips.
3) Sew velcro flush to each edge of crossback piece, on underside: Center strip, then extend onto back of packbag as far as necessary; sew.
4) Sew 3rd velcro strip centered parallel to other two (corresponding to harness)
5) Tie desired lengths of nylon cord thru each flap grommet, to be attached to tab grommets at bottom to hold flap down. One long length of cord thru the 3 grommets in packbag are cinched to close bag over contents.

In use, put harness on dog to comfortable fit, lay loaded (or unloaded) pack over harness. Velcro will stick. Hook clasps to D-rings for added support when dog sits. To remove pack, unhook clasps, then holding pack from underneath bags, "peel" pack off of harness.

If you wish to make a one-piece, non-harness pack from this pattern:

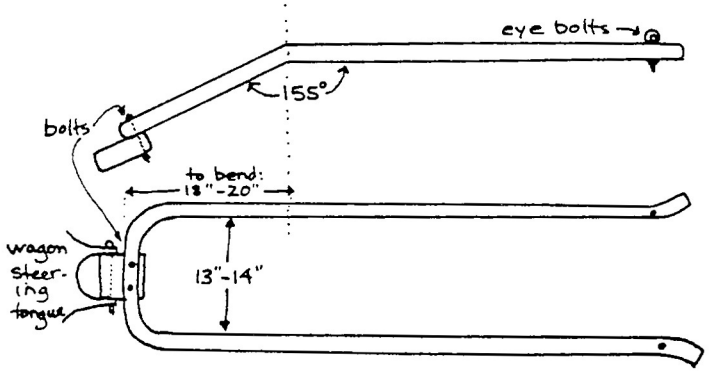
Make pack according to steps A and B.
In step C: cut webbing pieces A,B,D, and E, sew buckles on as specified. Sew piece A to front edge of crossback piece and piece B to back edge of crossback piece, with the center of the crossback piece 12" from the buckle end. Extend sewing of webbing piece 4" down the back of packbag (advisable to use an extra square of nylon to reinforce at the end of sewing webbing to packbag.) Sew pieces D and E 11" apart (centered from middle of crossback piece), sew to back of packbag. (again, reinforcement advisable).
Step D: Do only #5.

CHILD'S WOODEN WAGON - Conversion Instructions



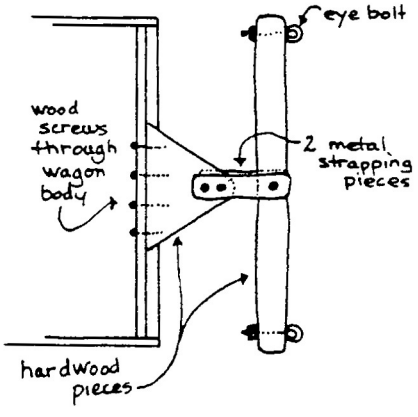
Materials needed:

Child's wooden wagon (with removeable fences) - 15"x34" bed, 9½" wheel diameter
available through Sears and most toy stores
8 ft. of 5/8" conduit tubing
3 pieces of hardwood (oak, birch, etc.) approx:
15"xl½"xl" (for singletree)
2"x5"x3" (cut to triangular shape with 5" base, 3" high)
2"x2"xl" (to attach shafts to steering tongue)
2 2"-bolts for tongue, 3 2½"-bolts for singletree attachment, 4 2½" eye bolts,
4 2½" wood screws, and the appropriate nuts and washers to go with them.



SHAFTS - for steering

Bend conduit tubing with conduit bender as specified. Bend into U-shape first, then bend proper angles. Drill holes & bolt to hardwood block, then secure block in steering tongue of wagon (instead of wagon handle). Drill holes & insert eye bolts at flared ends of shafts to act as brakes against dog's harness.

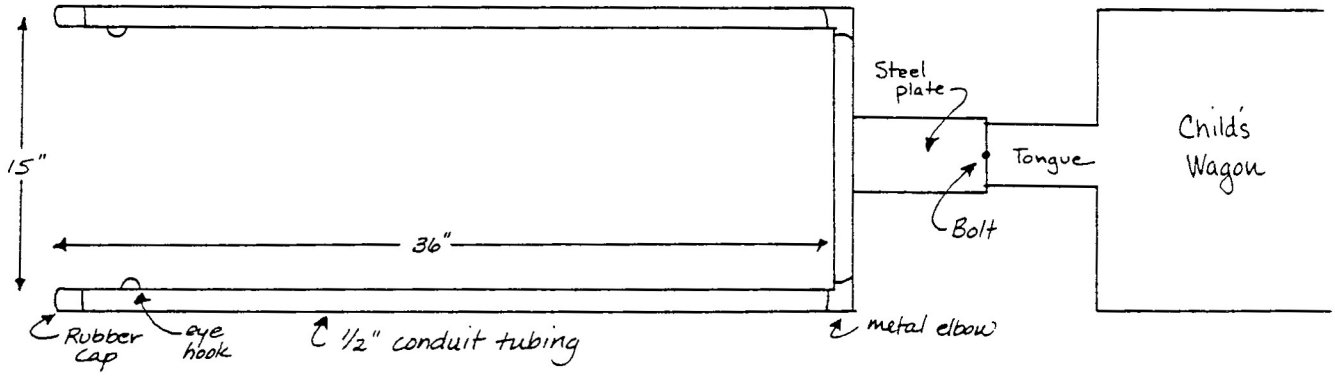


SINGLETREE - for pulling

Cut & finish the 2 hardwood pieces to the desired size: one triangular & one long & narrow. Triangular piece is mounted to wagon body very securely with wood screws. Drill holes in triangular piece & center of long piece. Bolt through metal strapping and wood pieces. Secure bolts tightly on triangular piece but leave play so that long piece can swivel. Insert eye bolts horizontally through ends of long piece for attaching traces.

designed by:
Roger and Consie Powell
5208 Olive Rd.
Raleigh, NC 27606

CHILD'S WAGON - Conversion Instructions



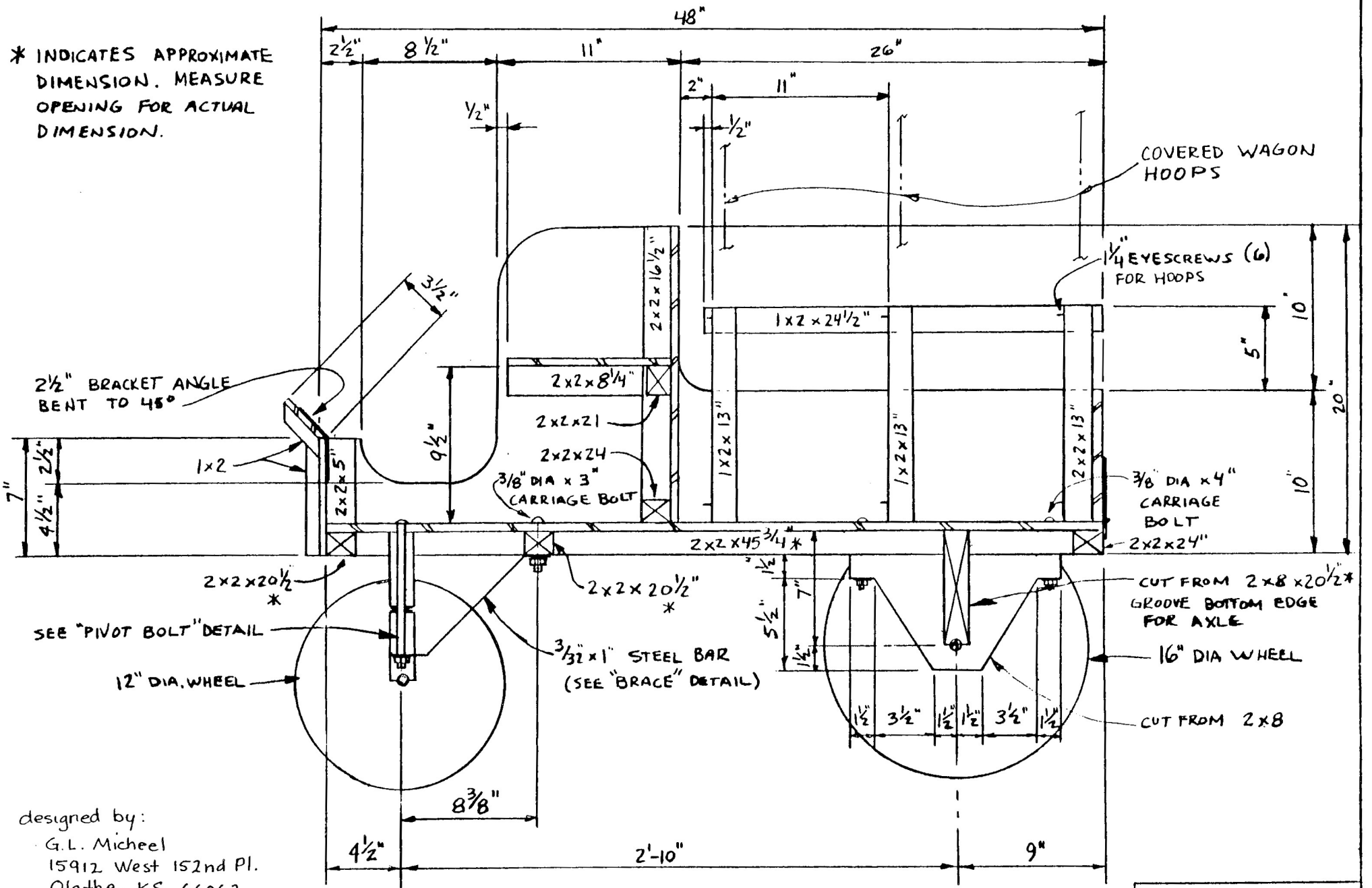
A child's wagon with a front end steering tongue should be used. The handle is removed from the tongue and the dog hauling adaptation is bolted in its place.

The draw bars are lightweight conduit tubing. The front ends are finished with rubber caps, and eye hooks are drilled onto the bars to connect to side harness rings. Metal elbows join the draw bars to a back piece of stainless steel (for more strength). Two heavy steel plates, 1" x 4" x ¼", are soldered to the back piece. A hole is drilled in each, through which the places are bolted to the steering tongue of the wagon.

designed by:

Norman and Sandra Beberman
136 Wilder Road, Whalom
Fitchburg, Mass. 01420

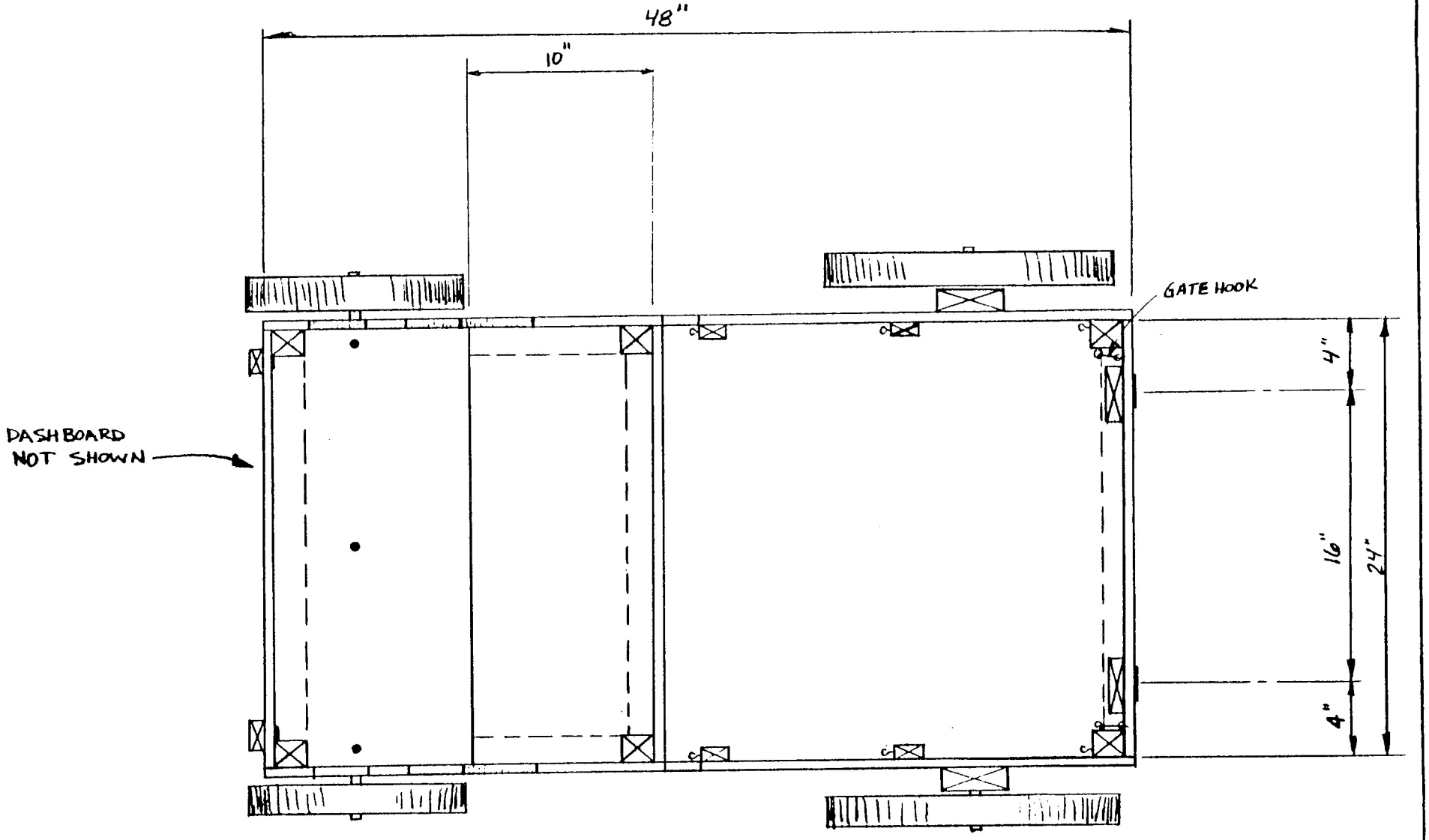
* INDICATES APPROXIMATE DIMENSION. MEASURE OPENING FOR ACTUAL DIMENSION.



SECTION CUT THROUGH CENTER

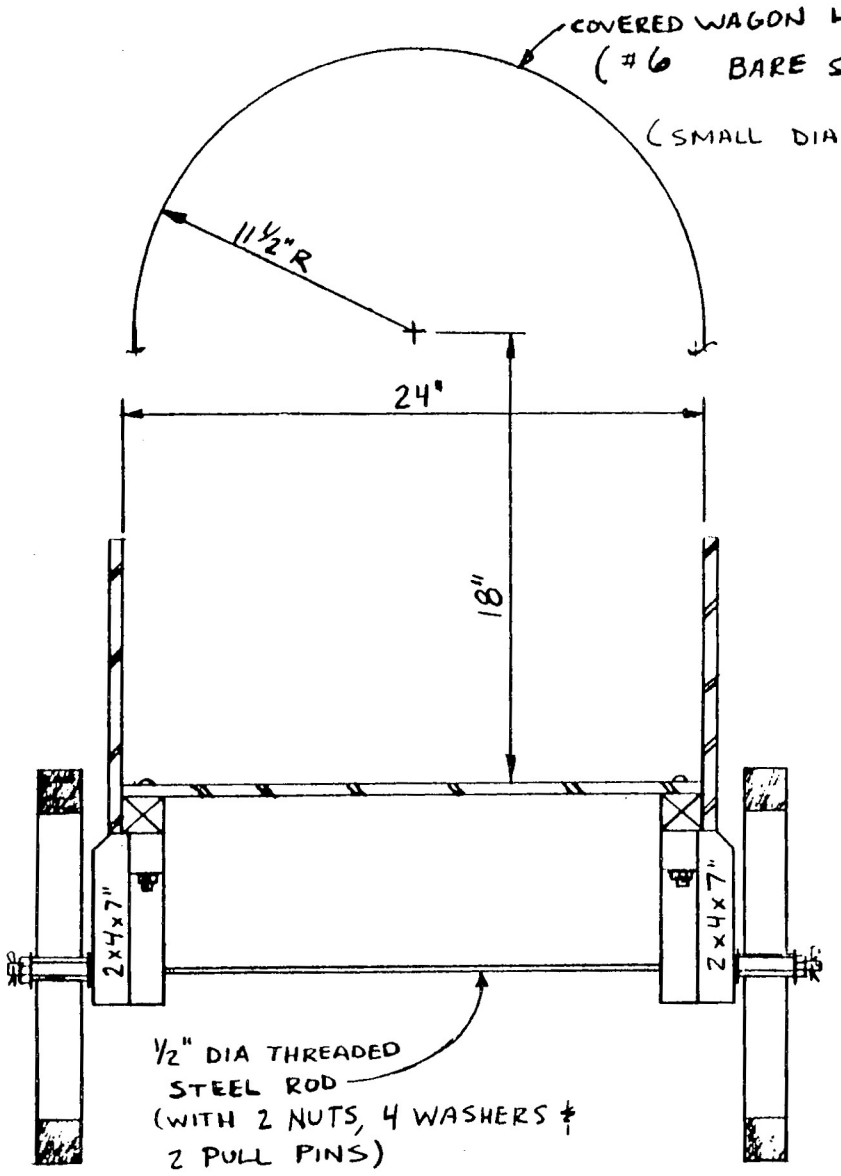
designed by:
G.L. Micheel
15912 West 152nd Pl.
Olathe, KS 66062
(913) 782-3412

MICHEEL WAGON	
G.L. Micheel	1½"=1'-0
2-18-83	SHEET 1

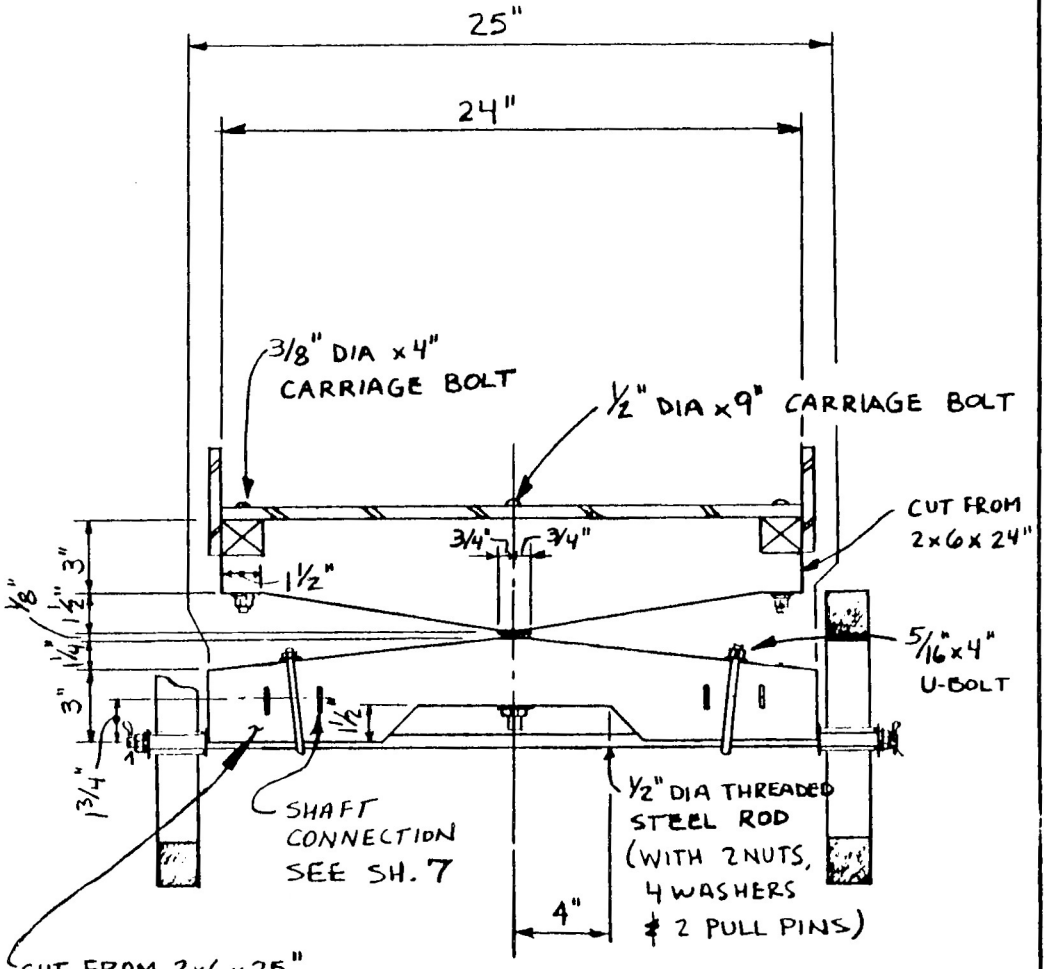


TOP VIEW

MICHEEL WAGON	
G L. Michee	1½"=1-0"
2-18-83	SHEET 2

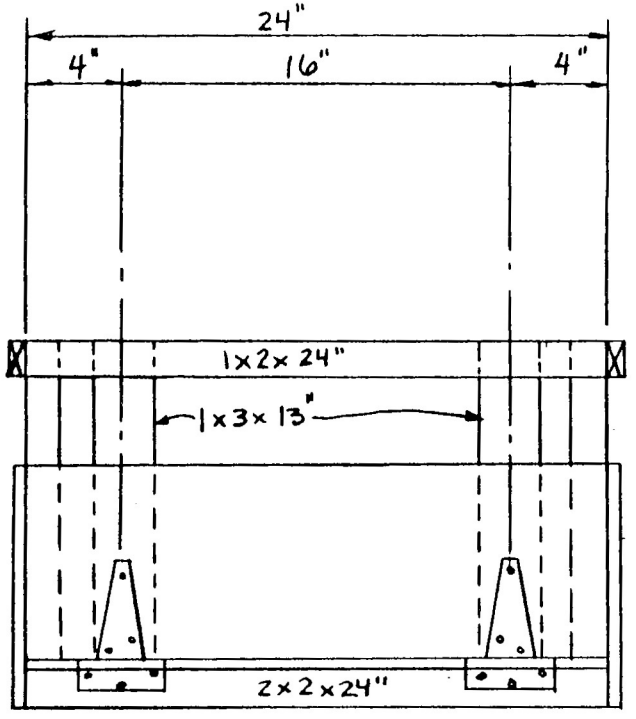


REAR AXLE

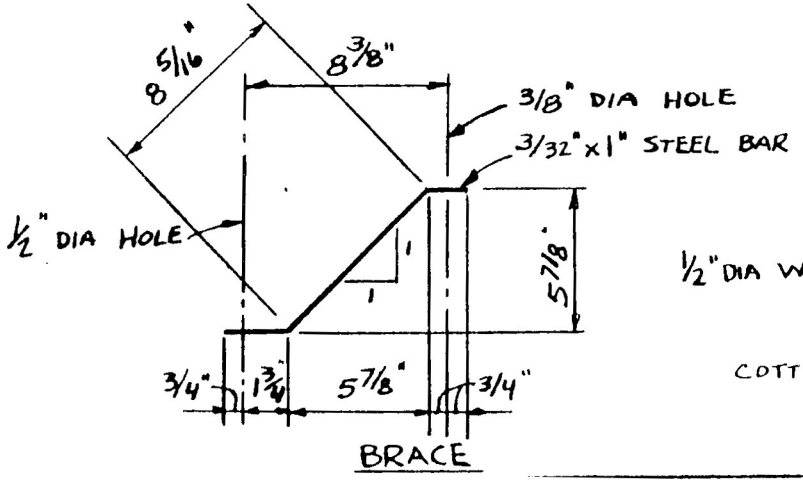


FRONT AXLE

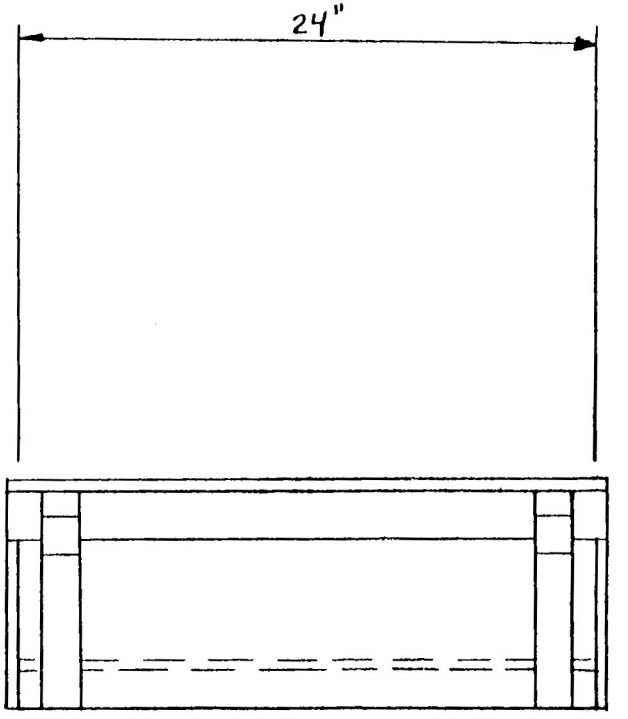
MICHEEL WAGON	
G.L. Micheel	1½"=1'0"
2-18-83	SHEET 3



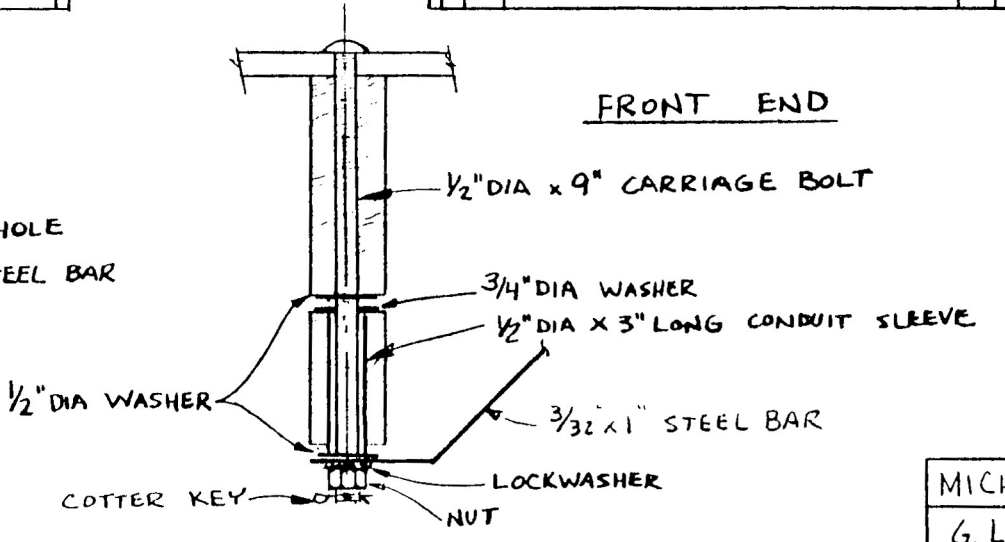
BACK END



BRACE

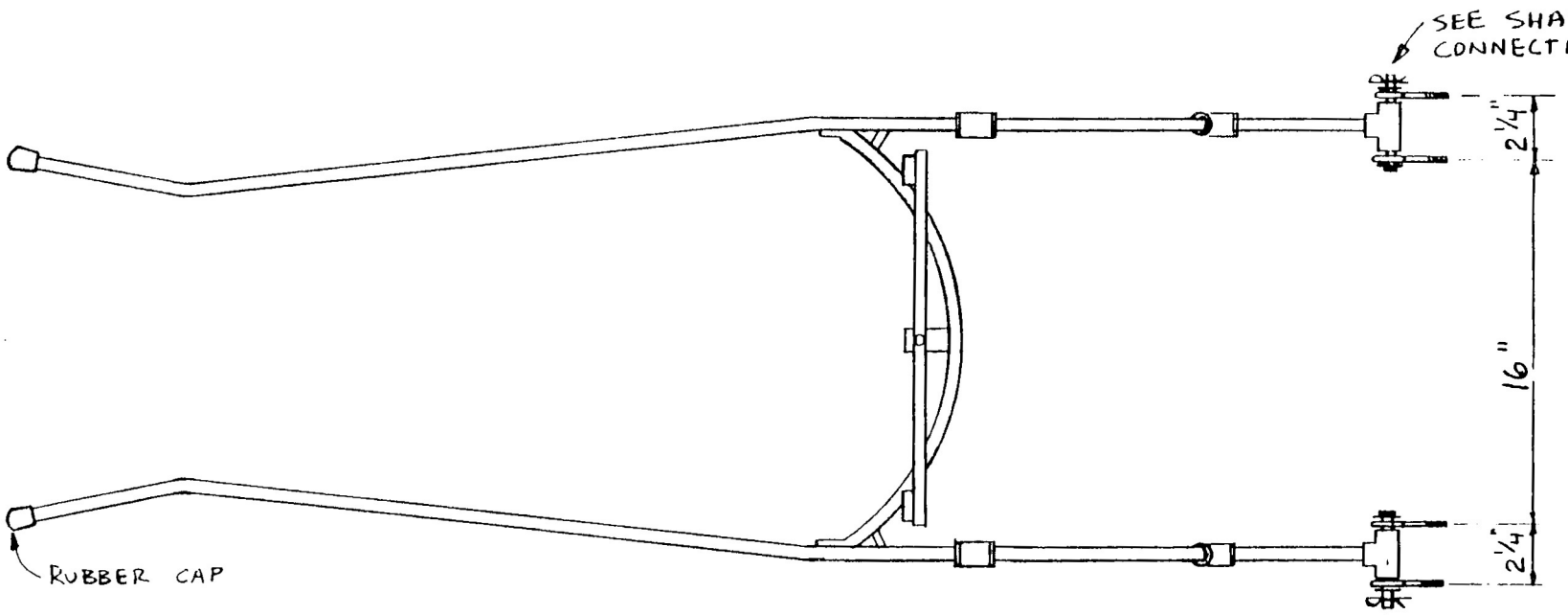


FRONT END

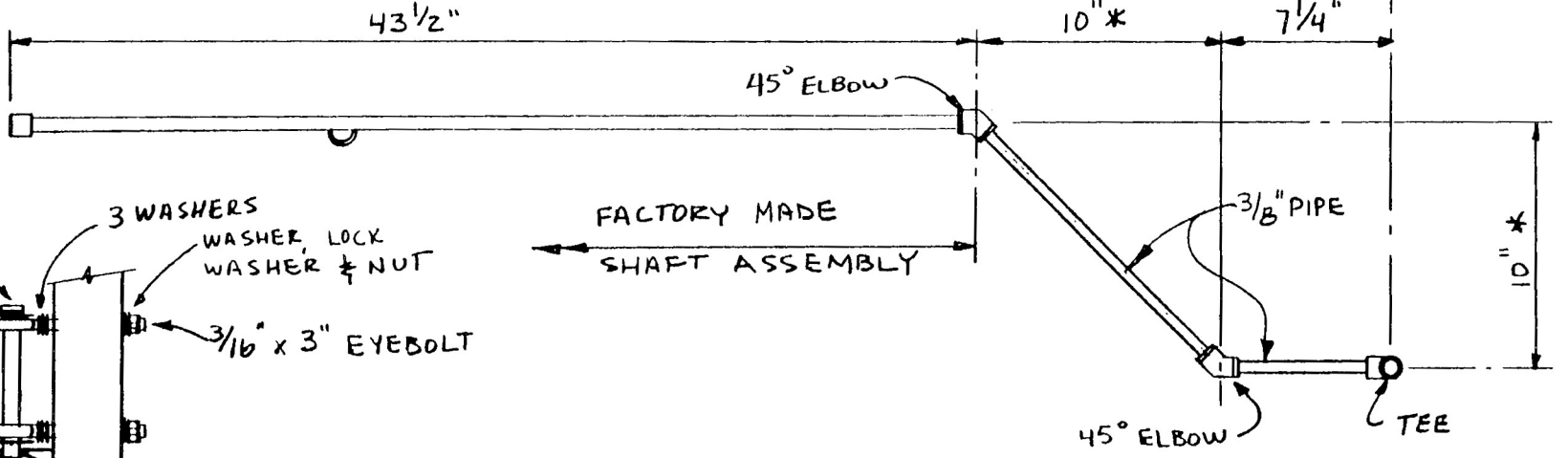


PIVOT BOLT (3"=1'-0")

MICHEEL WAGON	
G. L. Micheel	1½"=1'-0"
2-18-83	SHEET 4

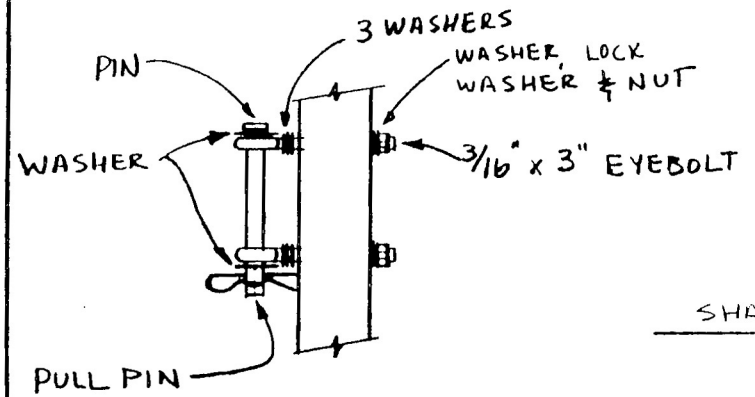


SHAFTS - TOP VIEW



SHAFTS - SIDE VIEW

* INDICATES APPROXIMATE DIMENSION
ADJUST FOR HEIGHT OF DOG



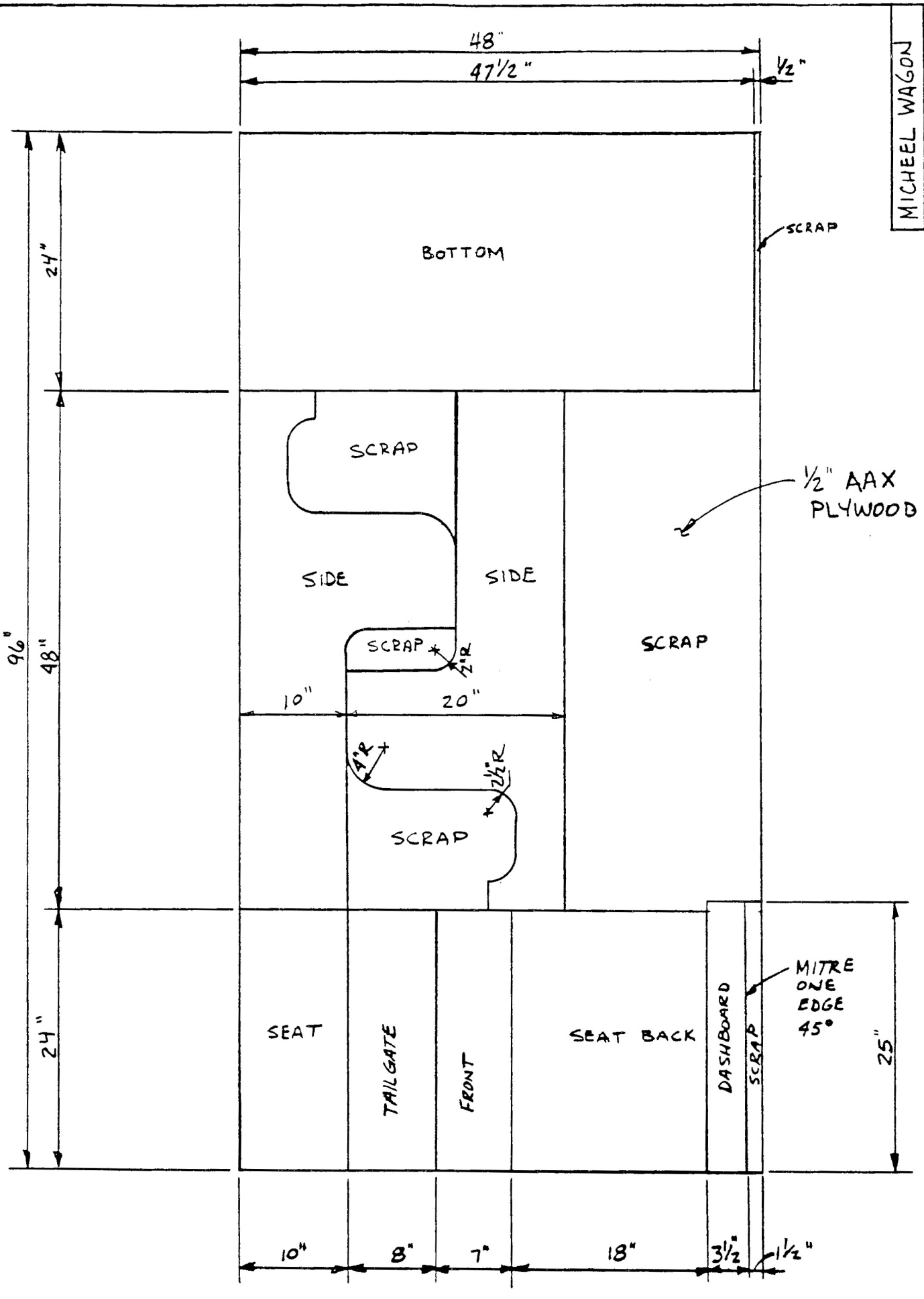
SHAFT CONNECTION DETAIL

MICHEEL WAGON	
G.L. Micheel	½"=1'-0"
2-18-83	SHEET 7

PARTS LIST - SHAFTS

MICHEEL WAGON | G.L. Micheel | 2-18-83 | SHEET 8

QTY	ITEM	COMMENTS	PRICE (FEB. '83)
1	DOG SHAFT ASSEMBLY (COMPLETE WITH SINGLETREE & LOOP RINGS FOR BACKING)	PEARSON'S 2704 N. WALNUT ST., P.O. BOX 2443, MUNCIE, IN 47302 (317) 289-2244 — ENDS MUST BE THREADED FOR COUPLINGS	40.00
4	45° ELBOWS, 3/8" DIA.		
2	TEE'S, 3/8" DIA		
1	3/8" DIA PIPE, APPROX 4 FT.	THREAD ENDS	
4	3/16" x 3" EYEBOLTS WITH 4 WASHERS, 1 LOCK WASHER & 1 NUT EACH		14.00
2	PINS WITH 2 WASHERS & 1 PULL PIN EACH		
			$54.00

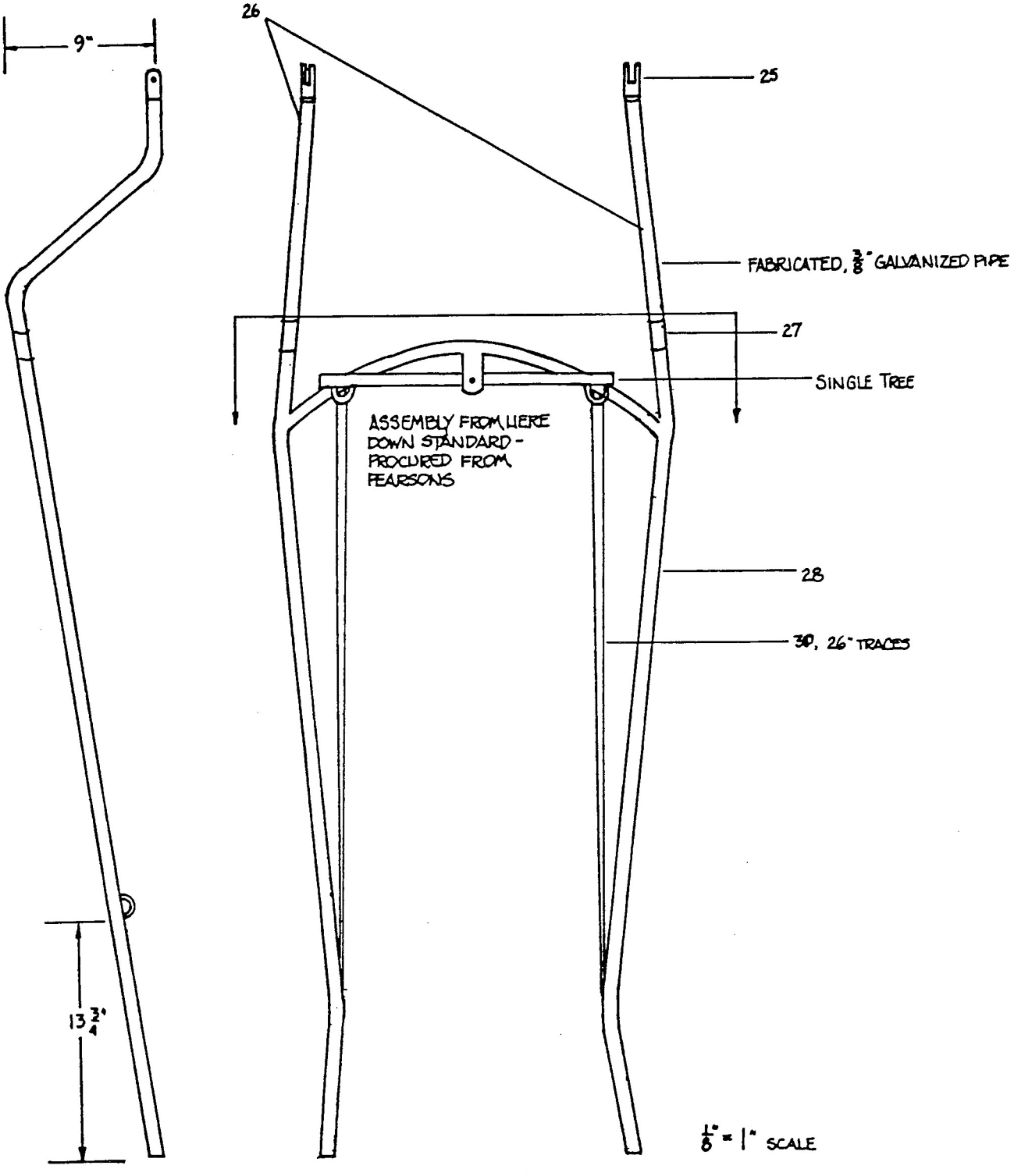


PLYWOOD CUTTING PLAN

PARTS LIST - WAGON

MICHEEL WAGON | G L Michael | 2-18-83 | SHEET 6

QTY.	ITEM	COMMENTS	PRICE (FEB. '83)
1	8'x4'x½" AAX PLYWOOD	(SANDED BOTH SIDES)	25.00
1	2x8x8'		4.20
1	2x6x8'		3.60
3	2x2x8'		2.50
1	1x3x8'		1.10
2	1x2x8'		1.70
1	2x4x8'		1.20
–	2" GALV NAILS		
–	1½" GALV NAILS		
–	1" WIRE BRADS		
1	3/8" x 3" CARRIAGE BOLT	WITH WASHER, LOCK WASHER & NUT	
6	3/8" x 4" CARRIAGE BOLTS	SAME	
1	½" x 9" CARRIAGE BOLT	WITH 2 WASHERS, LOCK WASHER, NUT, 3/4" OVERSIZE WASHER, COTTER KEY, & 3" LONG SLEEVE (CONDUIT)	
2	5/16" x 4" U-BOLTS	WITH LOCK WASHERS, NUTS & CROSS BAR	
1	3/32" x 1" x 13" FLAT STEEL BAR		27.00
2	2½" L BRACKETS	WITH 1" SCREWS	
2	4" BARN HINGES	WITH 3-1" SCREWS EACH, & 3-¼"x2½" BOLTS EACH., WITH LOCK WASHERS, WASHERS & NUTS	
12	1¼" EYESCREWS	FOR COVERED WAGON HOOPS	
2	SMALL GATEHOOKS (BRASS)	FOR TAIL GATE	
2	½" DIA x 36" THREADED STEEL RODS	WITH 2 NUTS, 4 WASHERS & 2 PULL PINS EACH	
1	18 FEET #6 BARE COPPER WIRE	CAN SUBSTITUTE SMALL DIA. PVC PIPE	
2	12" DIA WHEELS - PART NO. 171288	SUN METAL PRODUCTS, INC. P.O. Box 778, WARSAW, IN 46580 (219) 267-3281 (ASK FOR SAMPLE PURCHASE)	30.00
2	16" DIA WHEELS - PART NO. 171688		
1	QT FIRE ENGINE RED PAINT	HIGH GLOSS OIL BASE ENAMEL - (TOP)	7.10
1	PT BLACK PAINT	SAME (SHAFTS & UNDERSIDE)	4.90
1	PT MARINE SPAR VARNISH	HIGH GLOSS - (RAILS & DASH SUPPORTS)	7.70
	ELMERS WOOD GLUE		
1	1 YARD OF 60" WIDE HEAVY CLOTH	FOR COVERED WAGON TOP	4.10
			$120.10


9"
26
25
FABRICATED, 3/8" GALVANIZED PIPE
27
SINGLE TREE
ASSEMBLY FROM HERE DOWN STANDARD - PROCURED FROM PEARSONS
28
30, 26" TRACES
13 3/4"
1/6" = 1" SCALE

Variations of the Cabot Wagon using mostly wood.
Using the same parts as shown on dwg. 10878 but
with the following exceptions.

Body frame #4 and floor #29 are one unit of the same dimensions as the Alum. Floor is 3/4" outside plywood. The sides are 1" x 3" pine curved at the corners and glued and screwed to the floor. The curve is made using the kerf cutting technique. This makes a neat appearance and also allows a rounded surface in front for the shafts to move over when the handler manually lifts and turns the front axle.
Spacer #6 is made of a 2" x 4" kerf cut 360 deg., however three pieces with an open ended square would suffice to mount one side of the fifth wheel on.
The axle frame is made also of 2" x 4" pine and $\frac{1}{4}$" aluminum angles are mounted (bolted) to support the $\frac{1}{2}$" axle.

Wheels are laced chrome bicycle wheels, 16" front, and 20" rear with $\frac{1}{2}$" ball bearing centers. Sun Metal Prod. Co. Nos. 220022 and 220023 respectively. White side wall bike tires are mounted by a bicycle shop.

The removable seat (optional) is made with caned bottom and curved corners using again the kerf cutting technique.

The underside is painted in black enamel, the top and sides in fire hydrant red enamel with a black pin stripe around the top edge. The seat and dash board are painted in black enamel with a red pin stripe around the borders.

designed by

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SKELTON WAGON

designed by:
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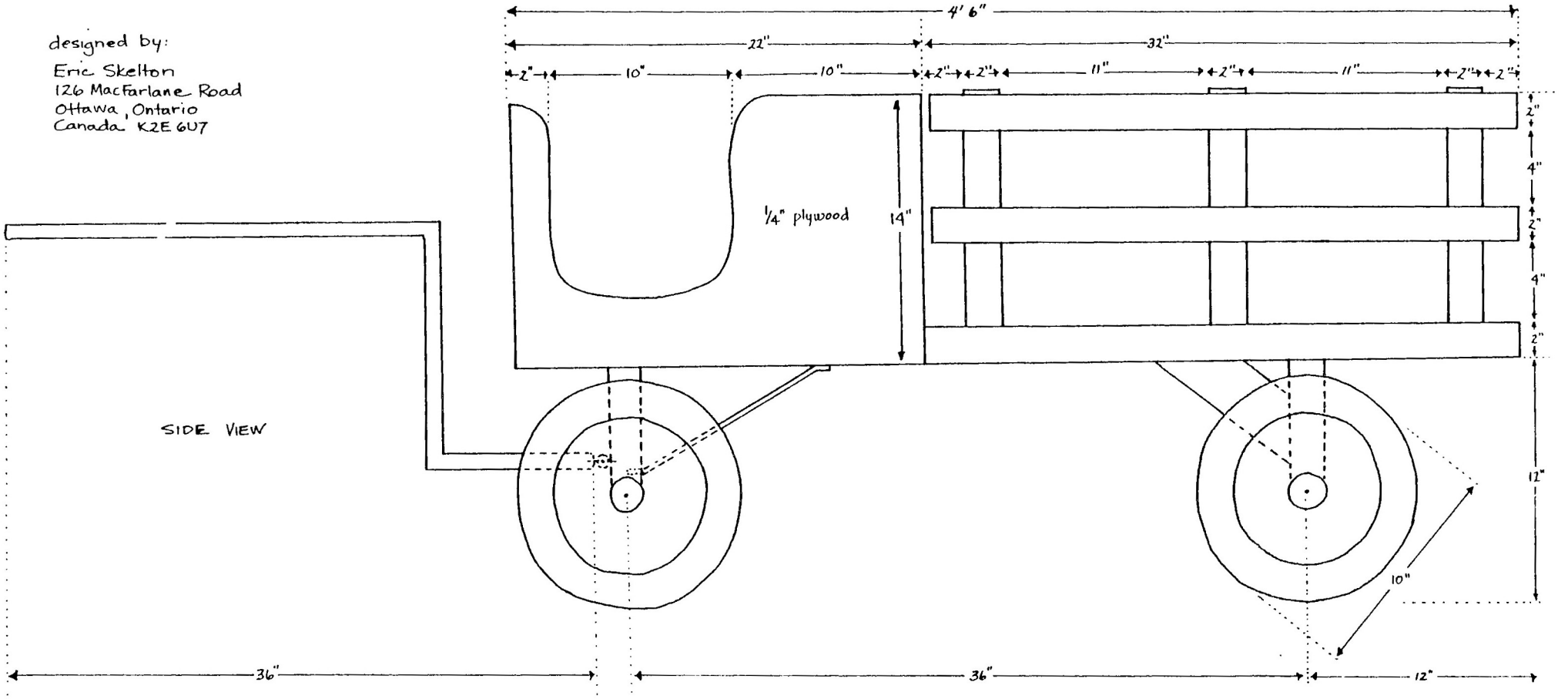
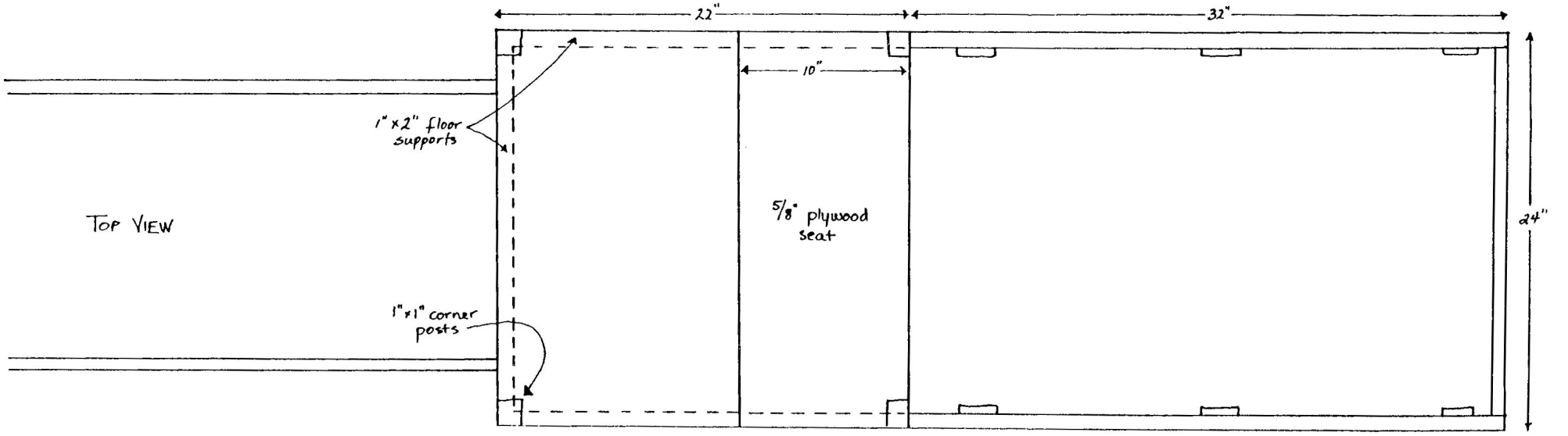
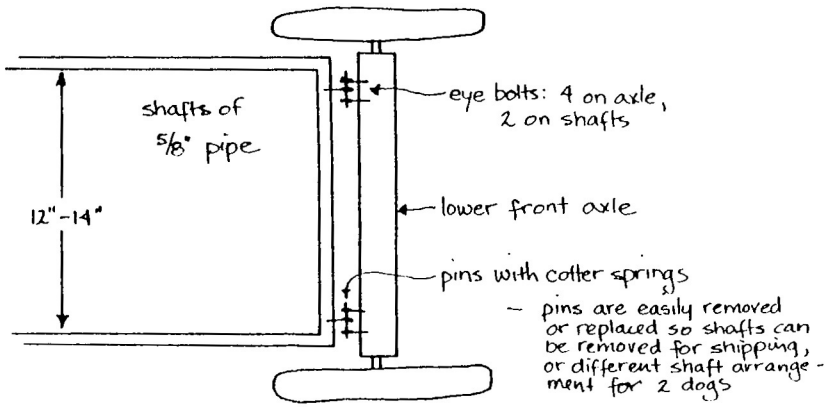


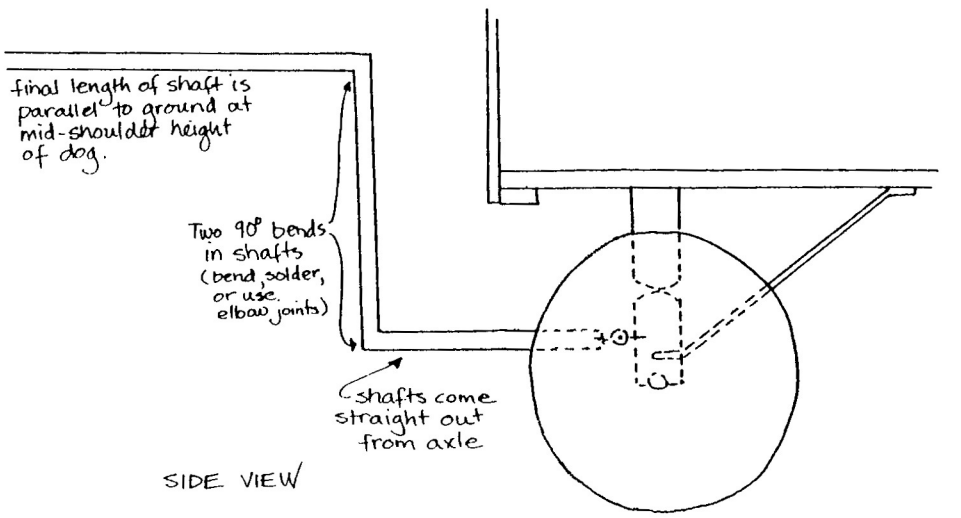


Skelton w/dgin

SHAFTS


shafts of 5/8" pipe
12"-14"
eye bolts: 4 on axle, 2 on shafts
lower front axle
pins with cotter springs
– pins are easily removed or replaced so shafts can be removed for shipping, or different shaft arrangement for 2 dogs

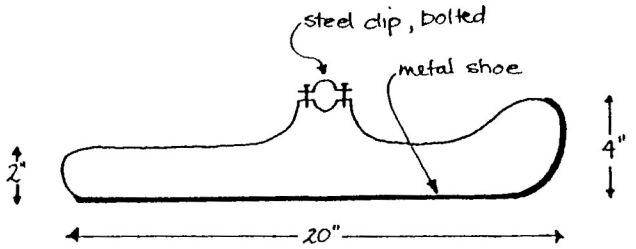
BOTTOM VIEW


final length of shaft is parallel to ground at mid-shoulder height of dog.
Two 90° bends in shafts (bend, solder, or use elbow joints)
shafts come straight out from axle

SIDE VIEW

RUNNERS

(FOR WINTER CONVERSION)
4 required



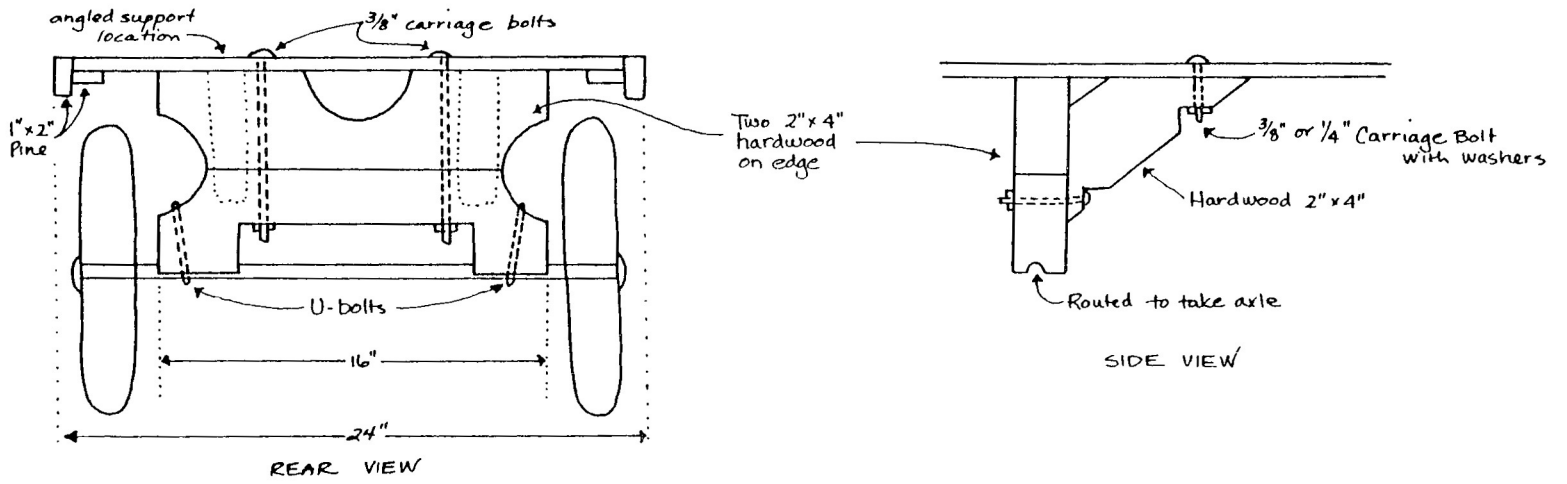
made of 2" x 4" hardwood with metal shoe on bottom (brass or steel, 2" x 1/8" ±)

MATERIALS REQUIRED FOR CART CONSTRUCTION

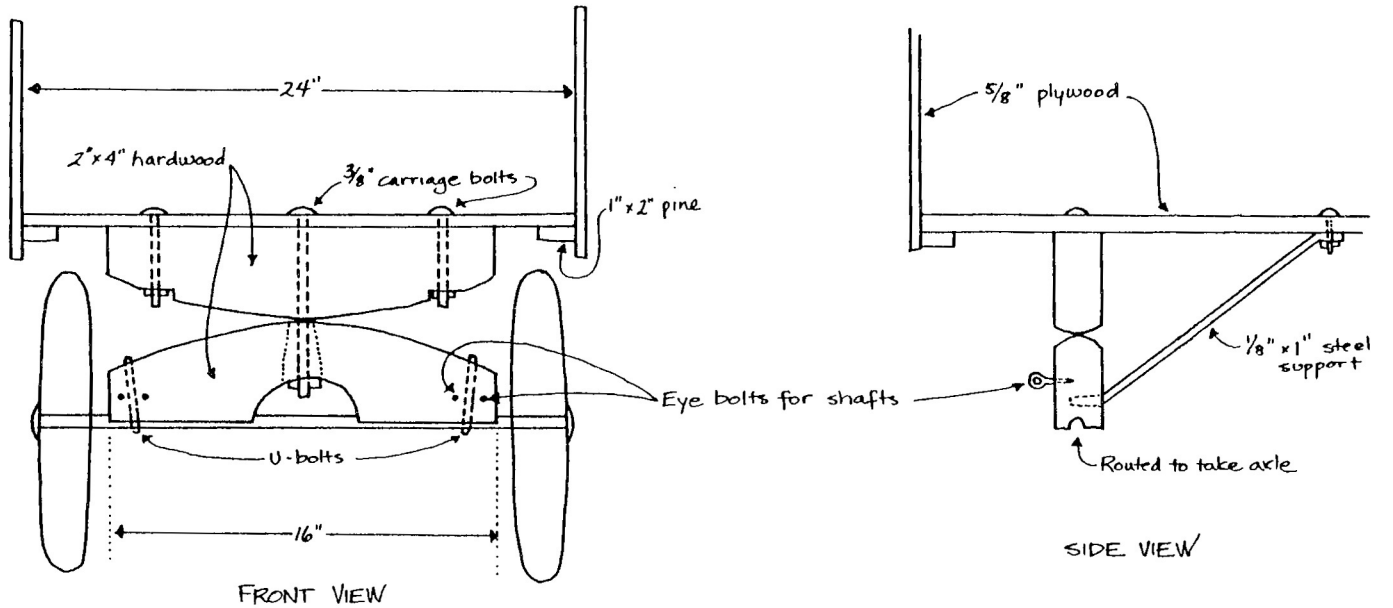
Floor: 5/8" plywood & 1" x 2" pine
Cab: 1/4" plywood with 5/8" plywood seat and 1" x 1" corner posts
Rack: 1" x 2" pine
Undercarriage: 2" x 4" oak (any wood will do)
Axles: 1/2" dull steel
Wheels: 10" with 1 3/4" solid rubber tires (needle bearings)
Shafts: 5/8" pipe with soldered fittings
Bolts, etc: as required

Skelton wagon

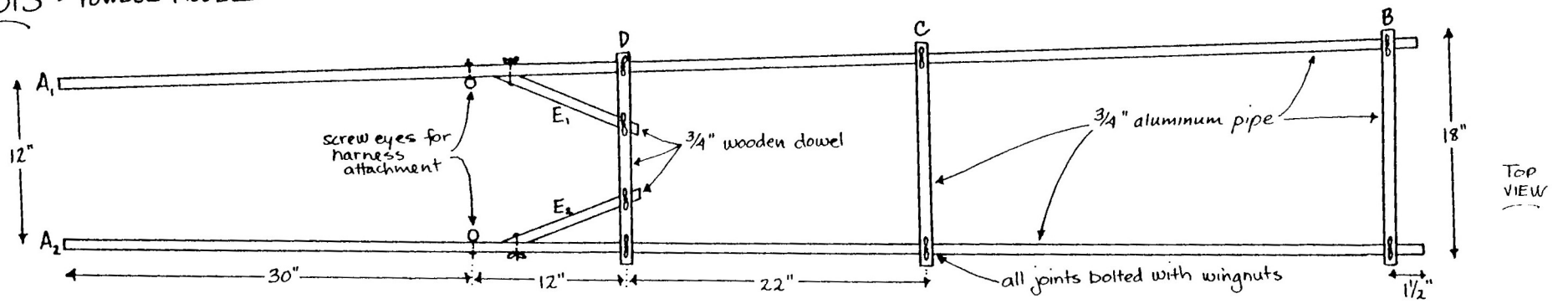
REAR AXLE AND UNDERCARRIAGE

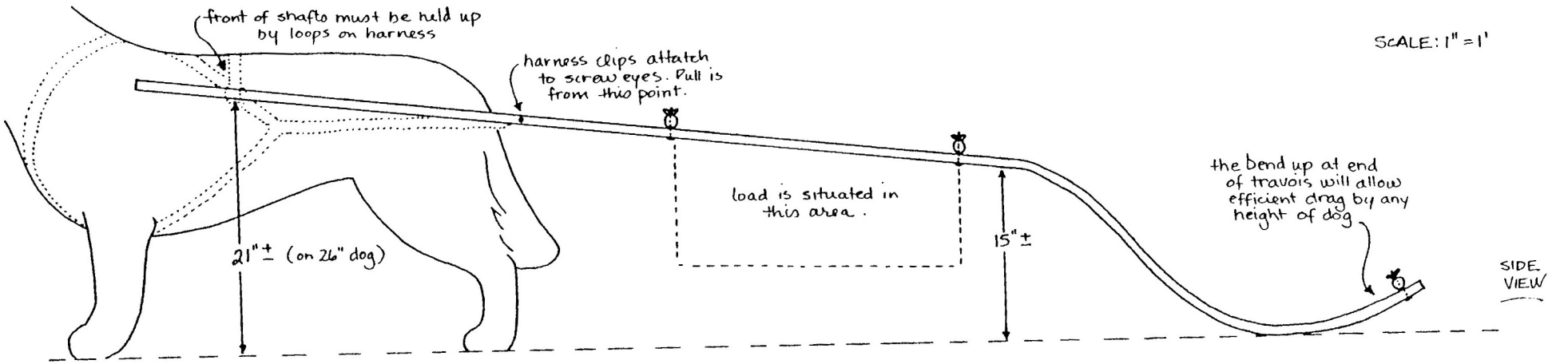


FRONT AXLE AND UNDERCARRIAGE



TRAVOIS - POWELL MODEL




front of shafts must be held up by loops on harness
harness clips attatch to screw eyes. Pull is from this point.
SCALE: 1" = 1'
load is situated in this area.
the bend up at end of travois will allow efficient drag by any height of dog
21" ± (on 26" dog)
15" ±
SIDE VIEW

MATERIALS NEEDED:

Two 10' long 3/4" aluminum pipes (conduit) - cut 18" length of pipe off each one for use as crossbars.

One 36" long 3/4" wooden dowel

Ten (10) 1/8" x 2" bolts

Ten (10) wingnuts

Two (2) 1/8" x 2" screw eye bolts with nuts and washers

DIRECTIONS FOR CONSTRUCTION

① Cut 18" off of each 10' length of pipe

② Tape the two long pieces of pipe (A_1 & A_2) together, bend (together for uniformity) to approximate curves shown in drawing (pipes bent only last 1/3 of length.)

③ While still taped, drill holes in top of A_1 & A_2 at locations for B, C, & D. Mark locations for drilling holes for screw eyes and front ends of E_1 & E_2.

④ Untape. Drill holes for screw eyes and front ends of E_1 & E_2 in sides of A_1 & A_2

⑤ Drill holes in ends of one of the 18" pieces of pipe (B). Bolt onto A_1 & A_2.

⑥ Adjust front ends of A_1 & A_2 at 12" apart. Locate the other 18" piece of pipe (C) over holes. Mark, drill, and bolt onto A_1 & A_2, making sure B and C are parallel.

⑦ Cut 15" piece of dowel (D). Locate over holes. Mark, drill, and bolt onto A_1 & A_2.

⑧ Cut 2 pieces of dowel (E_1 & E_2) of appropriate length to fit as shown in drawing. Cut at angle as shown, drill hole in side so E is flush with A and extends to fit snugly under D. Bolt in place.

⑨ Making sure all crossbars are parallel (D, C, B), drill through D and E_1 & E_2 at proper location and bolt firmly. Insert screw eyes in A_1 & A_2 securely.

⑩ Load may be tied between D and C, or a bag or basket may be fitted to carry the load.

designed by:
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CABOT CART

DWG 10878

Part No.	Part Name	Qty.	Material Spec.
1	Dash Board	1	1/8" plywood
2	Dash Supports	2	3/4" O.D. Electrical Conduit
3	Screws	6	5/8" self tapping metal screws
4 (note 1)	Body Frame	1	Welded aluminum frame
5	Channel brace	6	1¼" AL "U" channel, weld to frame
6	Spacer	2	8" AL tube welded to frame
7	5th wheel plate	2	3/8" AL 9" dia welded to spacer
8 (note 2)	Ball castors	4	Procure from castor supplier
9	Bolt	1	½" steel
10	Spring	1	Auto valve spring or equal
11	Washer	1	½" steel
12	Nut	1	Steel
13	Cotter pin	1	Steel
14(note 3)	Wheel, front	2	Semi pneumatic, wire spoke, ball bearing steel - 14" O.D. with ½" center holes
15	Wheel, rear	2	Semi pneumatic, wire spoke, ball bearing steel - 16" O.D. with ½" center holes
16	Axle, front and rear	2	Steel length cut to suit, each end tapped ¼" - 20
17	Bolt and washer	4	Brass ¼" - 20 beveled flat head
18(note 4)	Leaf Spring	2	Steel spring with ½" hole for axle. 2" W - 22" L.
19	Wedge Spacer	2	Wood
20	Carriage Bolts	4	5/16" x 6" with wing nuts
21	Seat (removable)	1	(optional) Wood
22	Eye Ends	2	Awning hardware
23	Pipe	2	3/8" pipe bolted to #24
24	Axle frame	1	Fabricate from available stock and bolted to part #7
25	Jaw ends	2	Awning hardward attaches to #22
26	Shaft extension	2	3/8" pipe
27	Coupling	2	3/8" pipe fitting
28(note 5)	Shaft assembly	1	Procure complete with singletree from Pearsons
29	Cart floor (cut in 2 pieces (to aid in installation)	2	3/8" plywood secured with 6 metal screws to #5
30	Traces	2	Harness and traces available from Digas Co.

Note 1: Frame is a section of electric "cable tray" used in electric utility plants. Mfg by Pearson & Wagner, Ind. Mr. Robert Pearson will possibly sell scrap pieces at $1.00/ lb when available. Pearson & Wagner. 3369 Progress Dr., Cornwell Heights, PA 19020

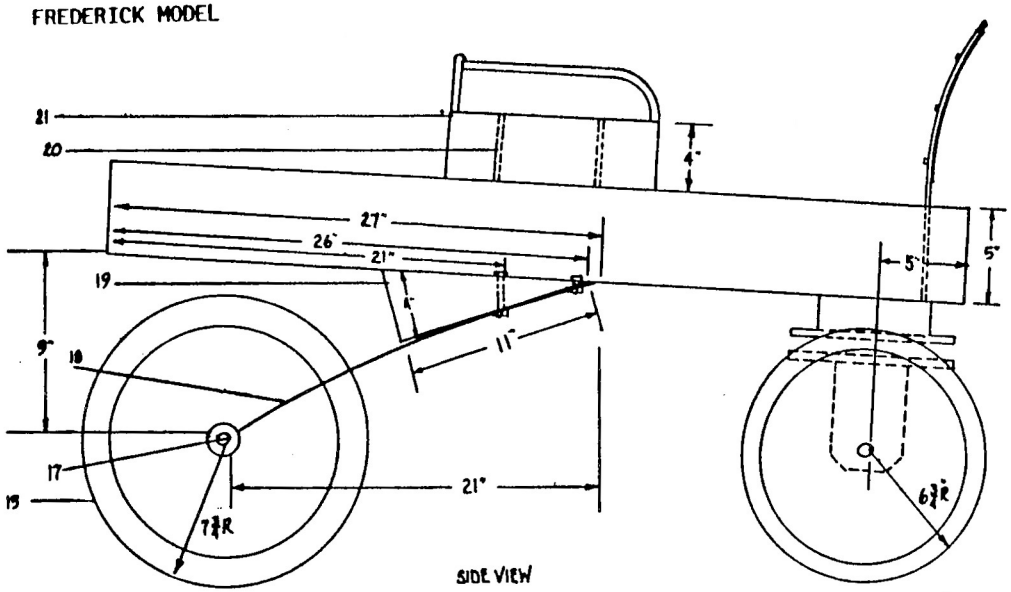
Note 2: Castors available from - Fred Hill & Son, Co., D & Luzerne Sts., Philadelphia, PA 19124. Part No. ACME 710A. Tel: (215) GA5-7500 or materials handling source from yellow pages.

Note 3: Wheels available from: Sun Prod. Co. Warsaw, Ind. 46580, tel: (219) 267-3281. Part Nos. - 14": 171488, 16": 172085 (ask for sample purchase).

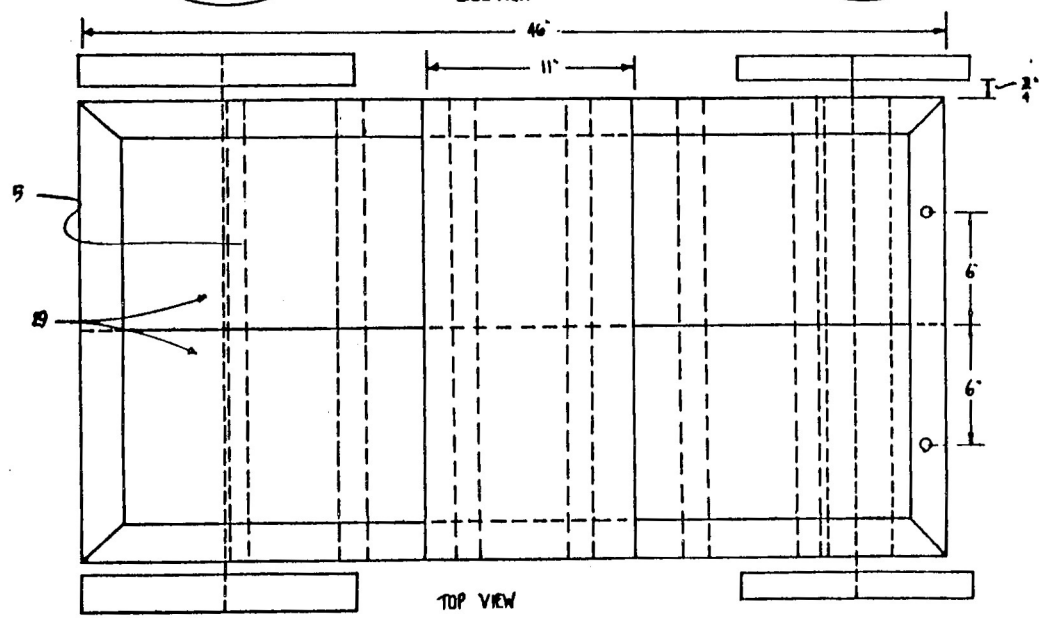
Note 4: Procured from an auto truck spring shop. They will cut and punch two 3/8" holes and cut to 22" length. Sucure with two 5/16" bolts. Make wedge washers to go under nuts.

Note 5: Pearsons. 2260 N. Walnut St. Muncie, Indiana 47305. tel: (317) 289-2244. Cat. No. 78. Dog shafts and single trees complete with loop rings on forward end of shafts (needed for backing.)

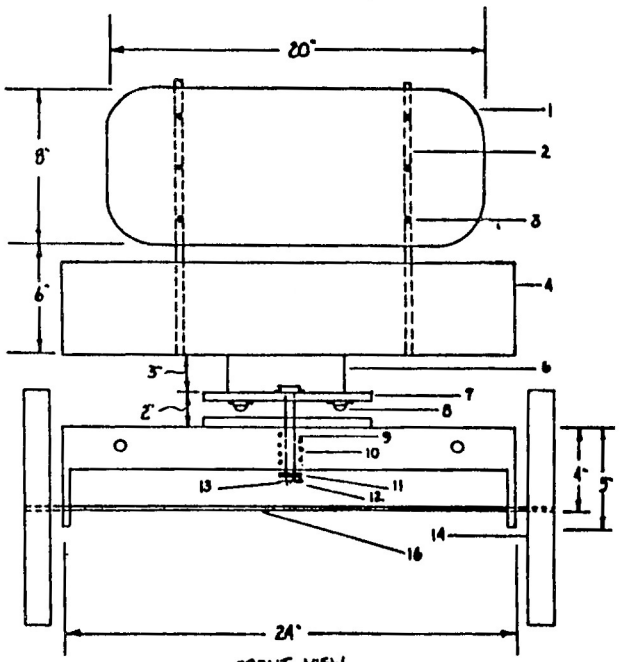
FREDERICK MODEL



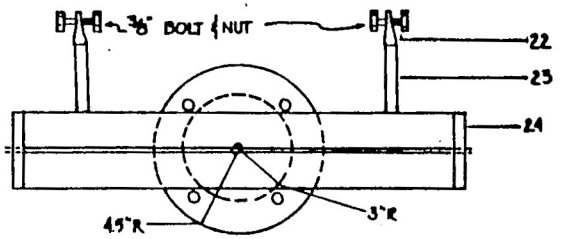
SIDE VIEW



TOP VIEW



FRONT VIEW



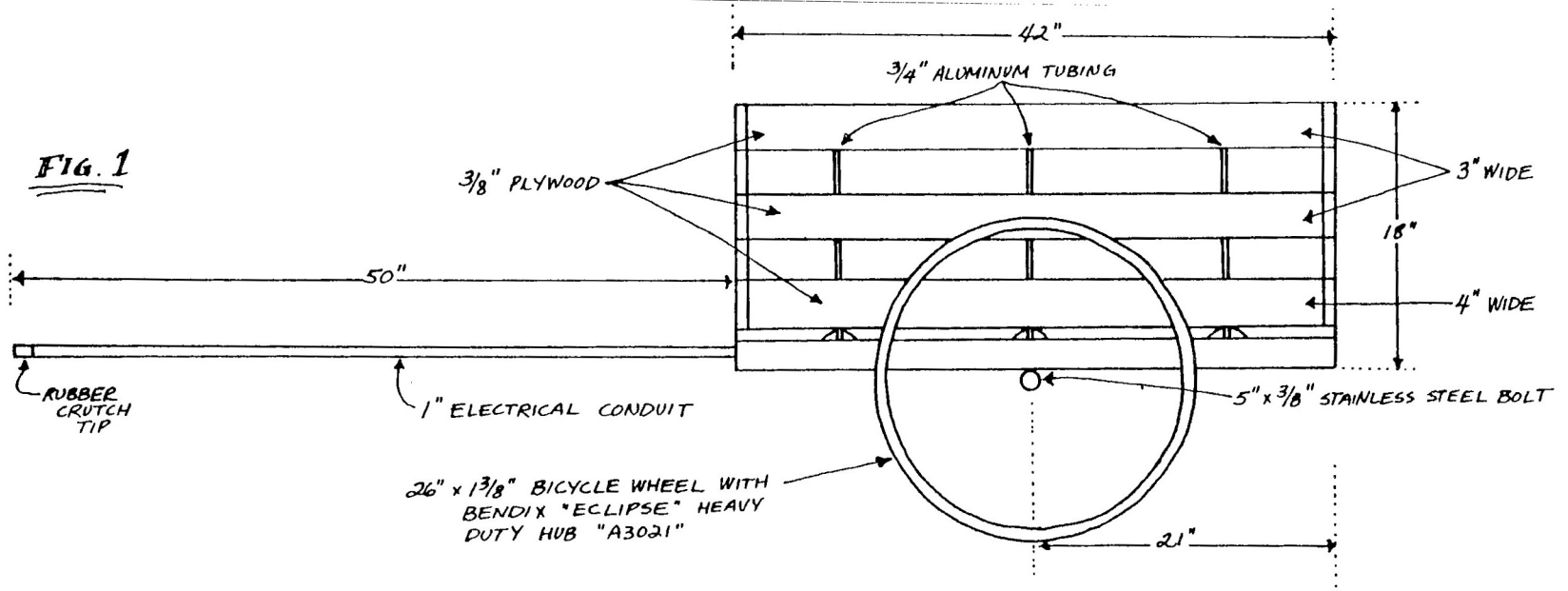
CABOT CART

DWG 10878

WT. 70 LBS. CART ALONE. TOTAL WT. 97 LBS.

SCALE: 0 2" 4" 6" 8" 12" ⅛" = 1"

FIG. 1



Designed by

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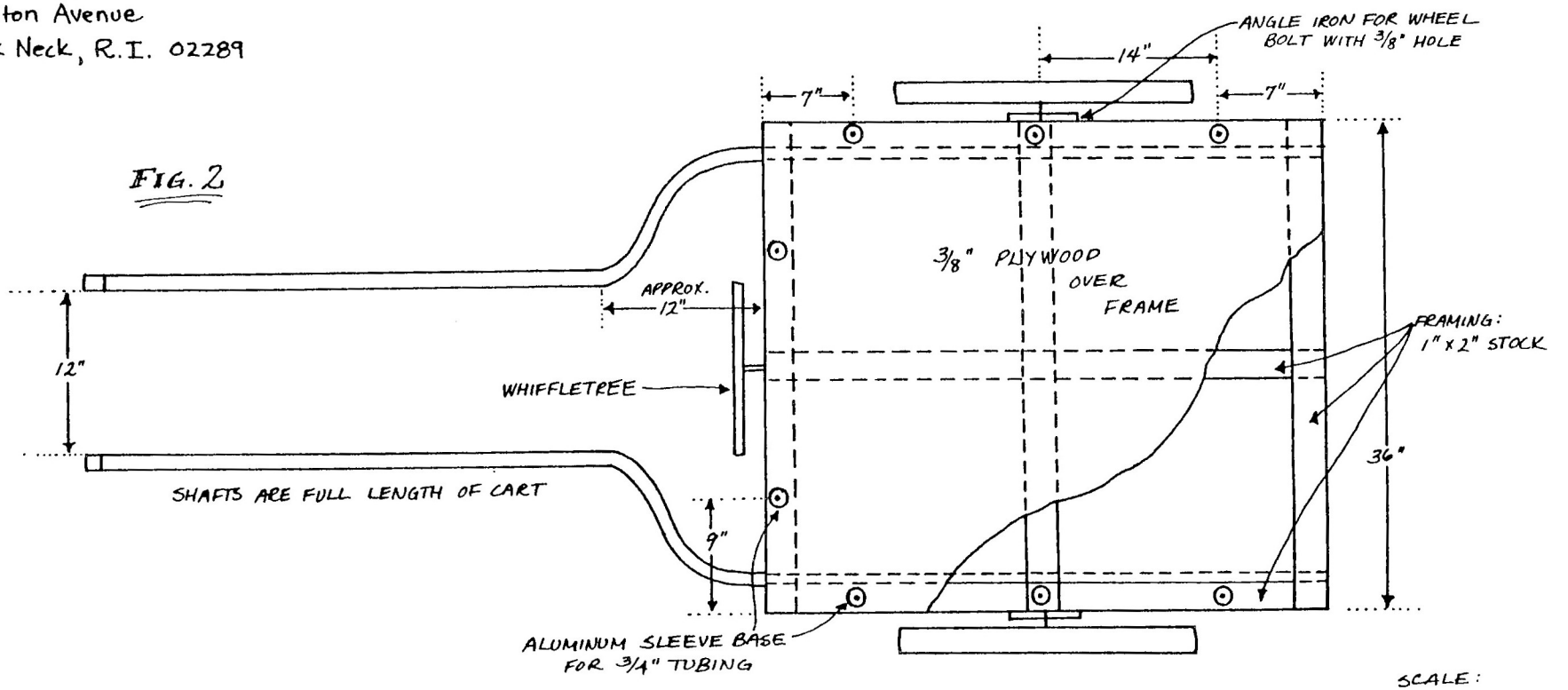
FIG. 2



SCALE:
1 inch = 1 foot

Holt model cart

Materials:

1) two 8' elec. conduit tubes: 1" dia.
2) two rubber crutch tips: 7/8" dia.
3) one 12' alum. tube 3/4" dia.
4) eight alum. bases for #3
5) 20' of 1"x2" stock
6) one sheet plywood: 4'x8'
7) two bicycle wheels: 26"x3/8"
8) two S.S. bolts: 5"x7/16"
9) one box sheet metal screws
10) two heavy angle irons with 3/8" holes on
11) wood screws

Directions:

1) Screw together bottom frame - fig. 2
2) Nail plywood over frame - fig. 2
3) Screw alum. bases on top of plywood - fig. 2
4) Bend shafts with pipe bender - fig. 2
5) Screw shafts into the three (3) cross members of frame
6) Bolt angle irons for wheel bolts
7) Cut and assemble two (2) side rails and front rail with sheet metal screws - fig. 1
8) Bolt wheels on

Harness arrangment at owner"s choice

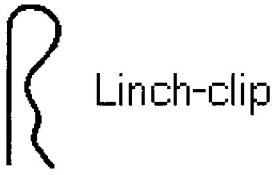
PVC Cart Plans

The advantages of the PVC cart are that it is extremely light weight, which is great for smaller or younger dogs. I built this one as a training cart, but still use it even for cart rides for smaller children (I bolt-and-wing-nut a small plastic lawn chair to the cart bed, with a nylon web safety belt). The major disadvantage is that it is relatively fragile; if a large dog panics getting up, he can easily snap the shafts. They can be repaired or replaced, of course.

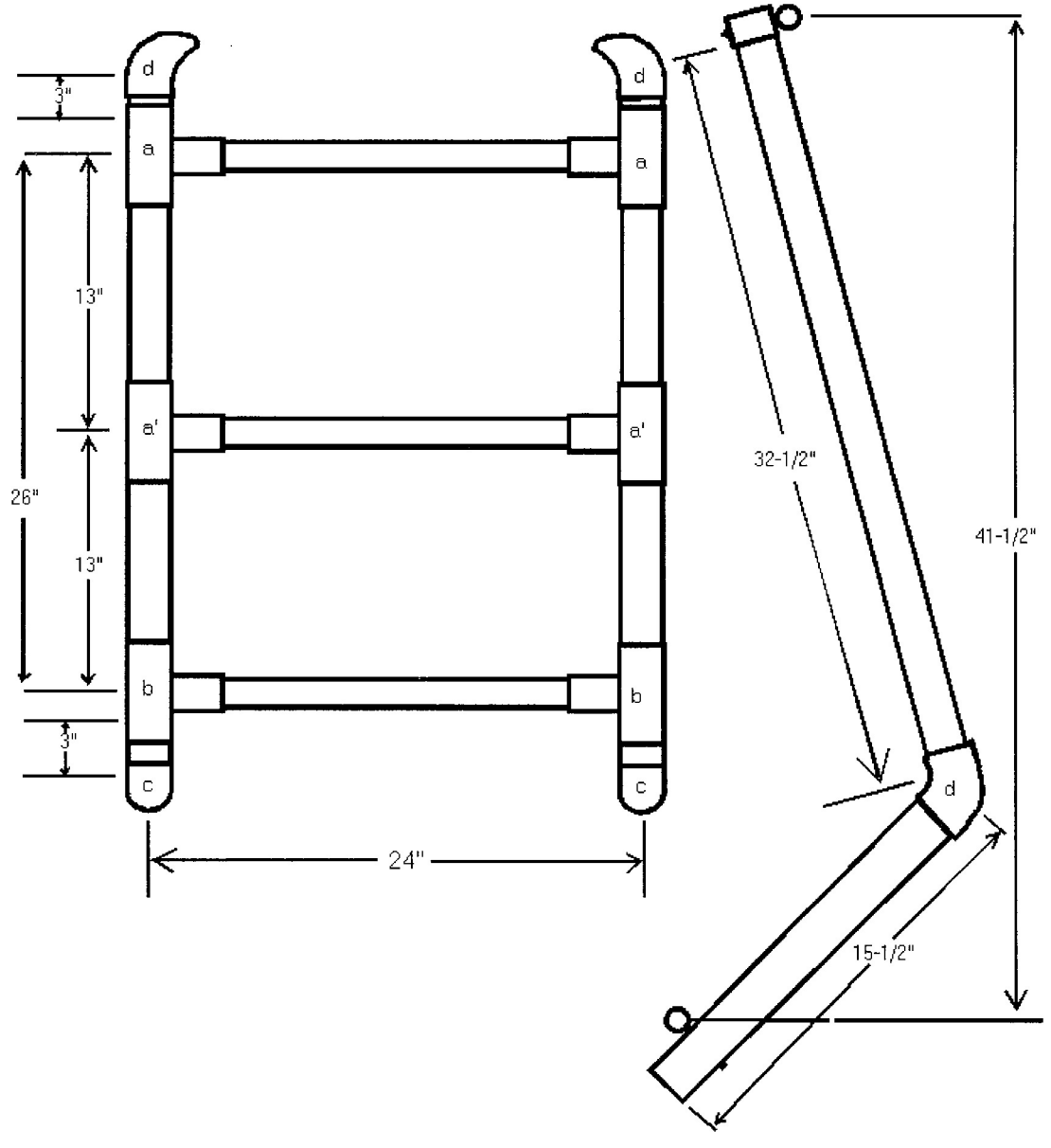
This cart is made from standard Schedule 40 1" PVC plumbing pipe and fittings with PVC glue at the fixed joints. (Schedule 20, the cheaper version, is far too fragile for the task). The shafts and the optional back (not shown on the plans) are not glued to the base fittings. Instead, like the wheels and axle, they slip into place and are secured either by linch-clips directly, or by linch-pins with linch-clips securing them

The enclosed plans show a bottom view of the cart bed and a side view of one of the two shafts. They do not show the optional back or the wheel and axle assembly, which I will describe below. They also do not show the cart floor, which is just a ¼" plywood piece attached to the bed with #10 round head machine screws (all the way through the pipe and fittings) with washers to take up the spaces between the pipe and the floor where there is no fitting. In other words, the washers make up for the missing fitting thickness between the floor and the PVC pipe. I put the floor on top of the pipe to result in a smooth surface.

PVC Draft Cart



Linch-clip



Parts labeled "a" are T-joints. With the optional back, the parts labeled "b" are also T-joints, but they can be replaced with right-angle fittings if you're not going to use a back. Parts labeled "c" are 90 fittings which support the back (which is just a U shape made with three lengths of pipe and two more 90 fittings, so that the legs come down and meet the upward-facing 90 fittings from the base).

Parts labeled "d" are 45 fittings. There are four - two at the front end of the base to accept the shafts, and one at the bend of each shaft

I made my cart 24" wide. I find that it has great stability with a base this wide , but it's easier to pass a draft test with a narrower cart (18" or so) - as long as your cart doesn't tip over. With a low center of gravity (put your weight flat on the bed of the cart), tipping over should not be a problem as long as you don't hit a tree root too hard!

Cut the lengths of PVC to achieve the spacing indicated in the plans. The dimensions given for the two pieces which make up each shaft are cut lengths, but those in the cart bottom are a little trickier: the 3" dimensions are cut lengths; the 13" and 26" dimensions are center to center (as is the 24" width). As I recall, the 1" fittings use up either ¾" or 1" of the end of the pipe; find out which, and adjust your lengths accordingly.

Before you do any gluing, figure out how you are going to affix the axle, as discussed below. More than likely, you will want to drill a ½" or 3/8" holes in each middle T fitting (a' in the diagram) with the axis of the hole running in the center of the center of the side fitting. In other words, the holes should be drilled so that a rod of the correct diameter for the wheels can pass through each T fitting wall (a') through the center of the central PVC cross-member of the cart base. There are a variety of ways to do this. If you can find PVC pipe which has the correct inside diameter (½" PVC pipe marketed for lawn sprinkler systems, and sold in many home improvement stores will, with some sanding, fit inside 1" Schedule 40 PVC pipe), a short length of that material placed in the side port of the T fitting will correctly guide a ½" bit through the wall of the fitting.

In any case, once you've drilled the hole in the central T fittings, assemble the base with all parts but "d" fittings glued in place. I assembled the cross pieces to three T fittings first, glued those three together to form one side (pressing the cross pieces to my table saw top to be sure they'd end up in the same plane), then glued the remaining side to the ends of the cross pieces. Then I glued the 3" stubs to each open T end. I glued together the back piece, and dry-assembled it to the 90 fittings so that they were properly aligned to the back during gluing. The trick is to work up some speed so the glue doesn't set up on you before you push everything home.

If you haven't worked with PVC before, experiment on scraps and extra fittings. You need to swab glue on both pipe and fitting, then press them home and hold them fully seated for 30 seconds. To be safe, buy and use PVC cleaner on both before applying the glue. It's typically a purple solvent which cleans the mating surfaces for best adhesion.

The shafts are unremarkable, as there is no need to worry about rotation as long as you wait until they are assembled before drilling for the two eye-bolts (¼" by long enough to penetrate). I glued dowels in each end (the open end of the short piece, and under the cap of the long (front) piece). This gives the PVC more strength where the linch-pin keeps it from twisting at the front end of the cart, and where the eye-bolt penetrates at each end so it won't collapse when you tighten the nut.

Setting the front 45 fittings is one of the trickier steps. They need to be angled in so they can hold the shafts one foot higher than the cart bed and 16" from each other, with the 16" gap centered at the front of the cart. Although at this point the shaft can turn in the fitting and the fitting can turn on the front of the cart, there is only one alignment of all four pieces (both shafts and both 45 fittings) which will produce parallel shafts (parallel to each other and to the plane of the cart bed) with the shafts 16" from each other. What I did was put the cart bed on a level surface (a floor will do, but watch out for the

each other. What I did was put the cart bed on a level surface (a floor will do, but watch out for the glue!) with the 45 fittings not yet glued, then affixed the shafts (also not glued). I fiddled until I had the position I wanted. I found that because the PVC will sag a bit, I had to support them at the front end. With straight edges at each cart bed edge, I could center the support, and align the shafts by measuring the support (ideally a 25" by 12" piece of scrap, with a mark at center and at 8" either side of center). I hope this is reasonably clear.

When you get the shafts and 45 fittings in the correct alignment dry (without glue), carefully mark each with a sharp knife - scribing both the shaft and the stub on the other end of the 45 fitting, and the fittings themselves. Then mark the scribe lines with a marking pen or otherwise so you can find them quickly and easily during gluing.

Then glue each 45 fitting to its stub at the front of the cart, carefully aligning the scribe lines on the fitting to its mate on the stub, so as to duplicate the alignment from the dry fitting. When the glue sets up firmly, insert the shaft into its 45 fitting with the scribe lines aligned. Recheck your spacing to make sure you still have the shafts 16" apart and parallel to each other and the ground. Then drill through both the fitting and the shaft for the linch pin (or clip).

The point here is to be able to insert a pin which will keep the shaft in the fitting, but will allow you to remove the shaft when you take the cart apart. I wouldn't recommend giving up and gluing the shaft in place, as it will almost certainly result in breakage when you are moving the unwieldy combination of shafts and cart into your car or van or truck. I think it important to drill for the pin as close to the center of the fitting and the portion of the shaft which is within the fitting to minimize the weakening which removing material surely causes. I've been using the cart for a long time now, and I have not had any breakage where the shafts connect. Remember that I have a wood dowel press-fitted into the end of the shaft to keep it from collapsing and to make it stronger where the shaft joins the cart.

My answer to a linch pin for the shafts is a ¼" hex-head machine bolt selected so that its unthreaded section is long enough to pass through the fitting and protrude at least 5/16" past the other side. I cut off the threads, and slightly chamfered the remaining end of the bolt to make it easier to pass it through both walls of the fitting and the end of the shaft. Then I drilled a small hole in that end to accept a small linch-clip (see the diagram for the profile of a linch-clip, which you can get at any good hardware store). To assemble the shafts to the cart, I align the shaft in the fitting, make sure visually that the holes are exactly in line. insert the linch-clip (from the bottom up), place a ¼" flat washer on the pin, and finally secure the pin with the linch-clip until I'm ready take the cart apart. I needed to sand down that end of each shaft to make it easy enough to insert and remove the shaft from the fitting, as they are too tight for comfort otherwise. Don't take off too much material. Water (spit, actually) is a great lubricant to aid insertion and positioning during assembly.

The same arrangement works for securing the back to the cart bed.

- Kris Cooper and Nana with the PVC Cart (back removed). The harness is secured at the very front of the shafts and near their rear with clips which hook onto eyebolts; each shaft also goes through a loop on the harness which is much more visible here than the front clip.

I've built three carts (counting a PVC training rig which is just wheels, two shafts, and an axle). On each, the really challenging part was the wheel and axle part. I've done it various ways, and it doesn't matter which cart is which - in each case, my solution depended on what wheels I started with. My first cart (the metal one I still use) has Troy-Built Tractor wheels. They are heavy (25 lbs) with ¾" shafts. I think they are too heavy for the PVC cart, and might even break it. The PVC cart has used 24" wheel chair wheels which take a ½" axle. (If your wheels are much different than 24" in diameter, you may have to alter the shaft dimensions to get them at the right height for your dog). To accommodate this, I used ½" hex head machine bolts bought to get the longest possible unthreaded section of shaft, with the threads cut off and the end filed smooth. I then inserted lengths of ½" PVC lawn sprinkler pipe (threaded nipples are available) into the 1" PVC pipe (some sanding was necessary) to achieve a ½" hole well into each side of the central T-fitting (a' in the diagram). I drilled a ½" hole from the inside of the T fitting, as described above. I inserted the hex-head axle through the wheel and into the cart, then drilled for a linch pin through the central member of the cart and the end of the axle. In use, a linch-clip (much larger than those which secure the linch pins at the ends of the shafts and back member of the car) to secure the axle.

A much easier arrangement is to buy a three foot length of unthreaded rod, drill near one end for a linch-clip, assemble the rod with a washer and linch clip on one end, both wheels, and the cart bed in between. Depending on your wheels, you may or may not need washers between the cart and the wheel. Then mark for a second hole so as to secure the wheels against the cart (with room to turn supplied by those washers, if necessary). Drill the second hole, cut of the remainder of the axle, and file it smooth.

The eye-bolts which are shown at the front end of the shaft and near the cart end (with enough distance from that end to clear the fitting on the cart which accepts the shaft) are ¼" eye bolts long enough to penetrate the cap on the front, with a nut and lock washer. I cut off the excess and peened the threaded end to make sure the nut didn't come off. The distance between the two eye-bolts on each shaft (41½") is right for our harnesses, which Judi Adler makes. If you get a Siwash or any other harness, you will have to alter these measurements to fit your harness.